creative computing

Feb 1979
vol 5, no 2
$2.00

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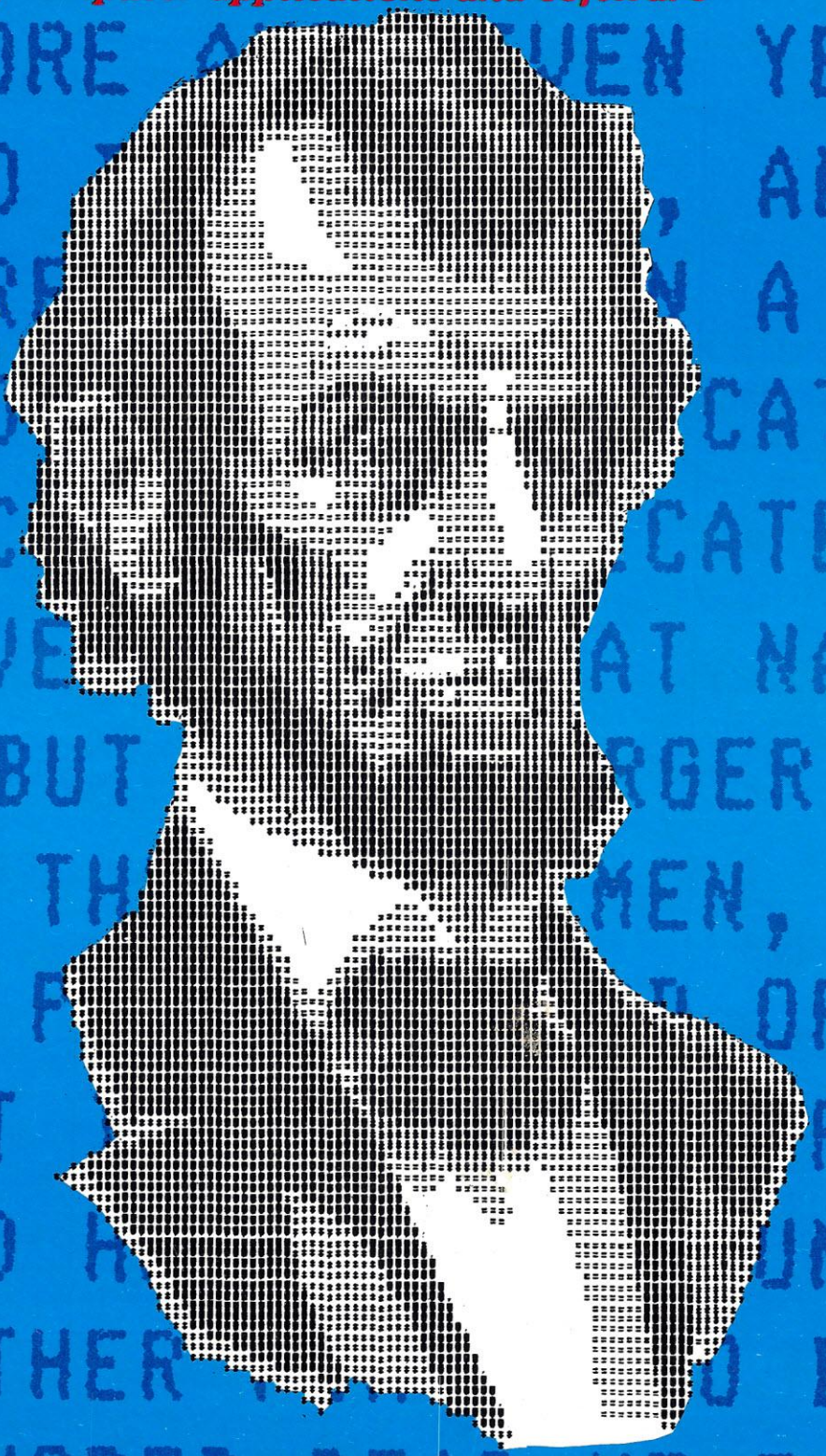

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Creative Computing magazine is published bi-monthly by Creative Computing, P.O. Box 789-M, Morristown, NJ 07960. (Editorial office: 51 Dumont Place, Morristown, NJ 07960. Phone: (201) 540-0445.)

Domestic Subscriptions: 12 issues, $15, 24 issues $28, 36 issues $40. Send subscription orders or change of address (P.O. Form 3575) to Creative Computing, P.O. Box 789-M, Morristown, NJ 07960. Call 800-631-8112 toll-free (in New Jersey call 201-540-0445) to order a subscription (to be charged only to a bank card).

Second class postage paid at Morristown, New Jersey and at additional mailing offices.

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Foreign Subscriptions:

Great Britain: 12 issues £13, 36 issues £36 (surface postage); 12 issues £22, 36 issues £63 (airmail). Orders and payment to Hazel Gordon, Plot 23, Andrew Close, Stoke Golding, Nuneaton CV13 6EL, England.

Australia: R. J. Hoess, Electronic Concepts Pty. Ltd., 52-58 Clarence St., Sydney NSW 2000, Australia.

Other Countries: 12 issues $23, 24 issues $44, 36 issues $64 (surface postage, U.S. dollars); 12 issues $39, 24 issues $76, 36 issues $112 (airmail postage, U.S. dollars). Orders to Creative Computing, P.O. Box 789-M, Morristown, NJ 07960, U.S.A.

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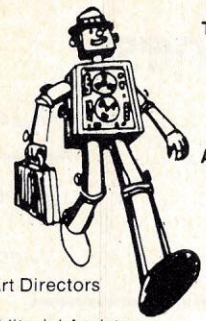

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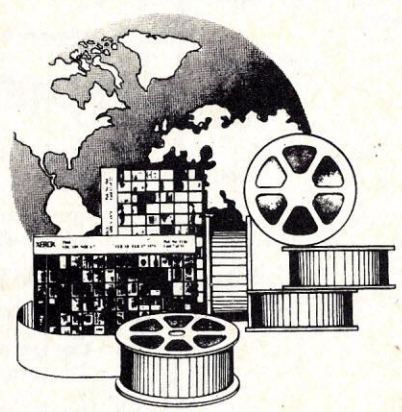

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...notices...

Floppy Disc Duplication — How to Do It?

Creative Computing's Software Division is in a predicament. We'd like to market floppy discs for the popular computers (Apple II, TRS-80, etc.), however, one-at-a-time disc duplication is too time consuming. We've been producing and verifying our CP/M 8" floppies one at a time but for a real mass production item it's net very economical. We've considered a system with three slaves and one master drive which represents an improvement by a factor of 2, but we'd really like an improvement by a factor of 10, or even 100! Any ideas out there? Preferably tried and proven. If so, please drop a note to: Creative Computing Software, P.O. Box 789-M, Morristown, NJ 07960.

Our Face is Red Dept.

On the Mailing List program by Gary Young in the Nov/Dec issue, pp 138-144, two lines we inadvertently left out of the listing. They are:

12100 RETURN
12200 S4 = 1

Sorry for any inconvenience.

Around the Creative Computing Jungle

Advertising Manager's desk. "Just a minute — I'll see if I can find your ad in our computer."

At the moment we have 21 people in our Dumont Place building which was originally designed for 7. This isn't as bad as the house in Hong Kong reported in The Guinness Book of World Records designed to house 12 people but which is occupied by 459, including 104 in one room. Nevertheless, we're jammed in; with luck by the time you read this, 14 of us will be in our new building on Washington Street. Hopefully!

MEMBER COSMEP

We're not just blowing smoke

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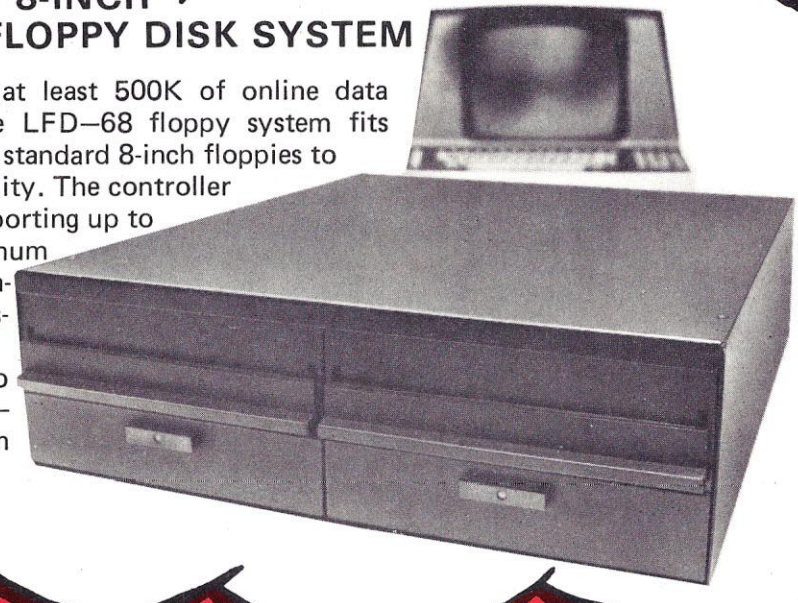

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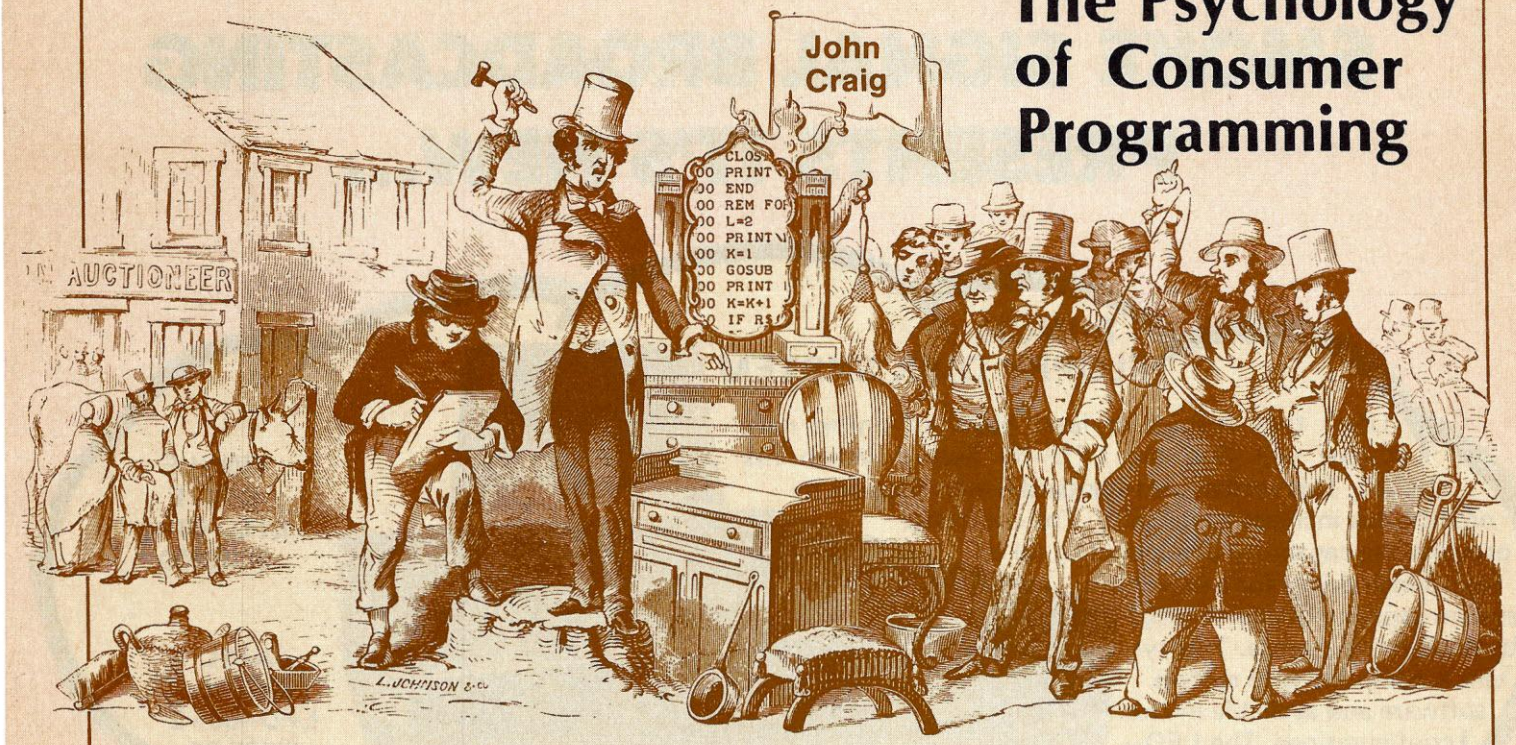
Editorial

The Psychology of Consumer Programming

John Craig



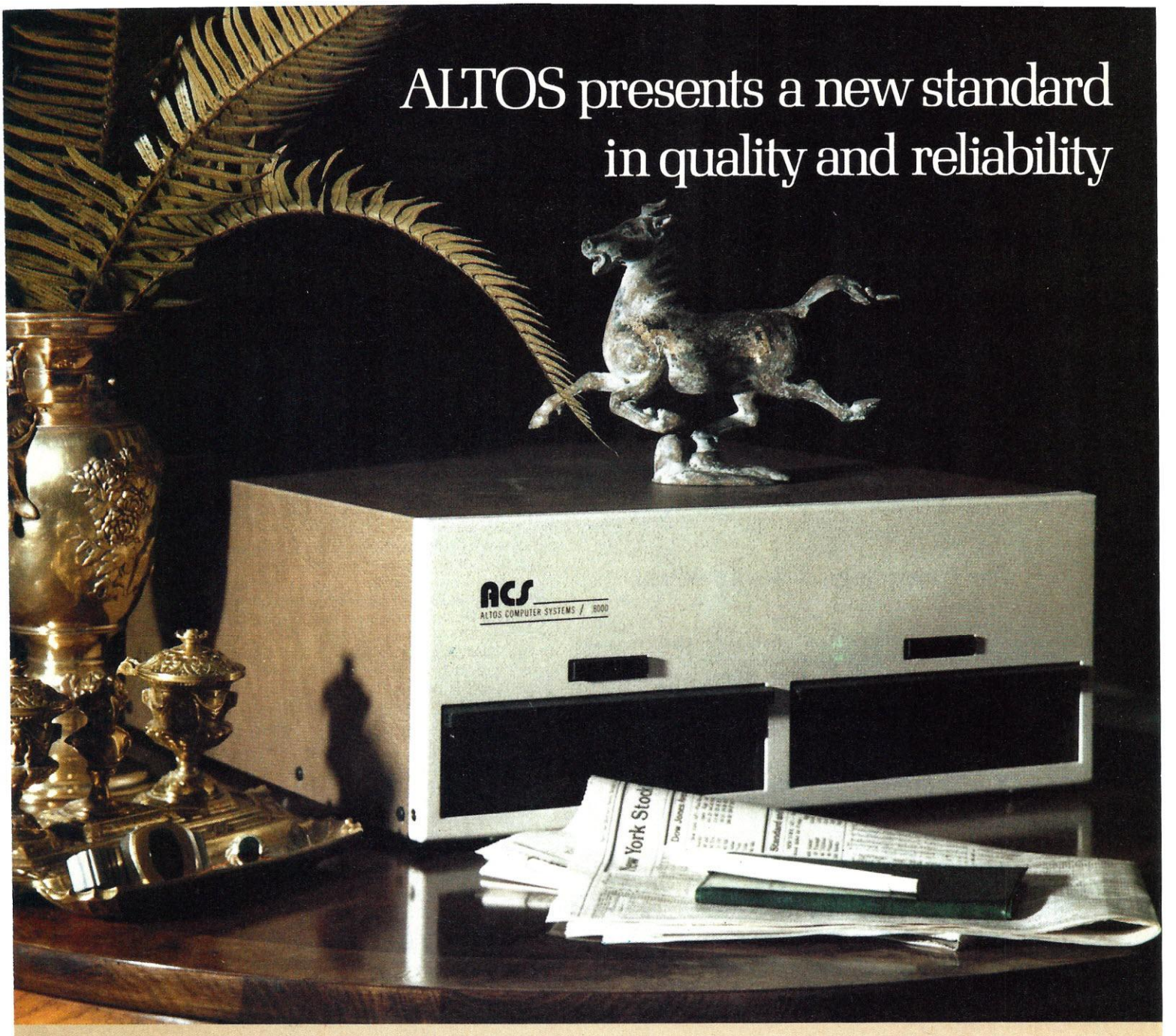
Have you noticed how much software is being developed these days which supposedly is aimed toward the end user or non-technical consumer? There's a lot of it...and a lot of it is baloney. Many programmers are having a rough time putting themselves into the shoes of that end user...and visualizing the problems with which they're going to be faced. Wouldn't a better approach be to have someone totally removed from the development of a package try it out and provide feedback to the programmer? We can't afford to turn people off with our software. This "user-orientation" ought to be foremost in our thinking when developing systems.

Much of the problem is just small things. For example, I recently ran an amortization program (definitely developed for a non-technical end user) which asked me to "ENTER OUTPUT DEVICE NUMBER (0-7)," It wasn't too big a deal for *me* to go back into my system's documentation and find out the device number of my printer and terminal. However, it would have been much more of a "project" for a novice to go in and find that information. The whole point is this: The expression "ENTER OUTPUT DEVICE NUMBER" is something directed toward *fellow computer professionals.* Something like, "DO YOU WANT PRINTED COPY OF PROGRAM OUTPUT (Y/N)?" would have done the trick just as well...and certainly been something everyone could answer without any trouble.

Another area which deserves close examination is documentation. This is frequently a big bugaboo and the thing which gets the least attention. With consumer-oriented software we can't afford to let documentation go out the door which makes a lot of assumptions about what that user knows. People will get turned off if they get frustrated! What the heck, if a piece of software can get me worked up into a lather...imagine what it could do to the poor novice. I recently had an experience with a piece of software which drove me buggy because of all the assumptions made by the programmer ... and were reflected in the documentation. Once again, it was just simple things ... like failing to mention that you needed to run Program A before you could run Program B. I have very strong feelings that the programmer should not be the person who writes the manual on using a program. That programmer is just naturally going to make assumptions because he's been so close to the project ... assumptions which will be disastrous.

One of the few exceptions I've seen to this "programmer-writing-the-manual" situation is the data base program called Whatsit. Lyall Morrill did a fantastic job of describing how his package should be used by the non-technical end user. As a matter of fact, he included a section in the back with technical details...for those who can use that information. Dick Milewski (The Software Works) has a single sheet he includes with his Mail Room package which describes "How you can make Mail Room do something in the first 5 minutes — before reading the manual." What an idea! It does wonders for instilling confidence in the software and certainly shows how easy it is to operate. Another feature in Mail Room which is certainly worth mentioning is the "Soundex" technique he employed. This allows for misspelling of names...and the computer will search for those which "sound" like the name typed in. Forgiving software such as this will be a big plus in that consumer market!

Perhaps we've fallen into this situation because most of us simply don't think in terms of an untrained person walking up to a computer and using it. We've been around computers in our work environments and schools and we know from those experiences that people must be trained before getting near systems. People can operate these complicated monsters without training if we design the software with that objective in mind. Let's start taking a closer look at these situations, okay? In the long run we'll be looking out for ourselves *as well as that end user.* ■



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Brackets show disk capacity per standard two drive system. All models come standard with 32 Kb RAM and two 8″ disk drives as shown above. Expansion to 64 Kb is $363 per 16 Kb. FPP, DMA, software optional. Dealer/OEM discounts available. Delivery: 30 days ARO, all models.

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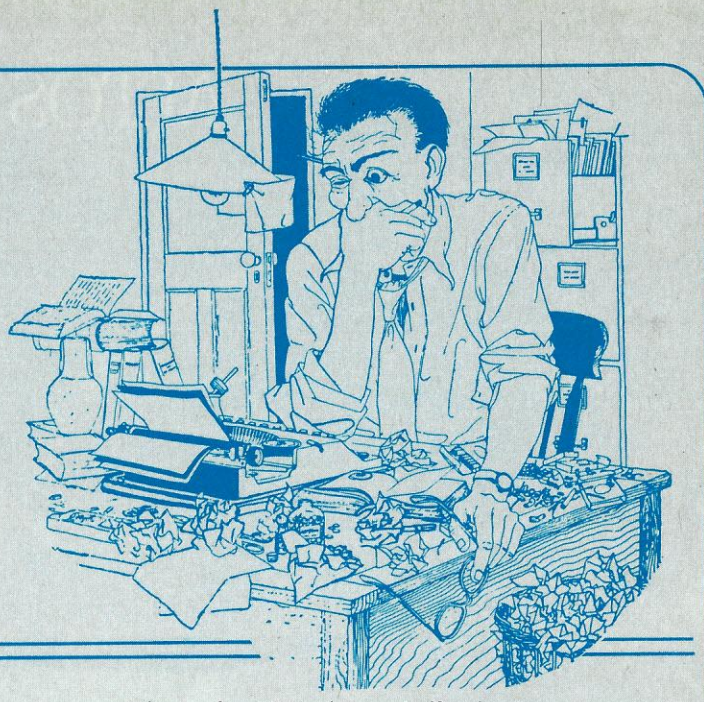

The Cryptologists Strike Again

Dear Editor:

With reference to John Soto's short note, Generation of Acronyms By Buzzword INtegration (GABBING) in the Nov-Dec 1978 issue we should like to better inform your readers. A little known cryptologic secret is the fact that HAL is a Caesar encipherment of IBM. Simply add 1 to all letters of HAL to decipher it. Another decipherment scheme would be to subtract a 1 from each letter of the word. Try this out on BIM!!

We suggest that you stop publishing such highly speculative stuff and give your readers the truth on origins of such things pertaining to cryptology. Better yet tell them to send us a note and we shall give them information on CRYPTOLOGIA, a journal devoted to all aspects of cryptology, which will give them cryptologic literacy in the same way you have given all of us computer literacy.

Brian J. Winkel, Editor
Assistant Professor of Mathematics
Albion College
Albion, MI 49224

I don't know, Brian, the way you slipped that plug in there was pretty sneaky! —JTC.

An Open Letter to the CP/M Users Group

Anthony R. Gold
CP/M User's Group
345 East 86 Street Apt. 18D
New York, NY 10028

Dear Mr. Gold:

In a letter contained in the first volume of the CP/M User's Group library, you state that it is your intention to prevent the accidental distribution of any proprietary or copyrighted software. We believe that you have made an attempt to do this.

Unfortunately, this has not actually been the case. We note with dismay that nearly all of the programs that we have published in the past in our magazine, books and software discs are being distributed by your group, without our permission or knowledge.

Most people are quick to realize the incredible amount of work that goes into writing an assembler or BASIC interpreter and respect the rights of their authors. But when it comes to computer games and application programs, you seem to forget your manners. The only way we can continue to bring you and other CP/M users more programs is if people buy our products, compensating us for all the time and effort it takes us to collect and publish programs. We understand that your activities are ostensibly non-profit, and of course we have no objections when someone uses one of our programs for himself or possibly gives a copy to a friend. But we can not allow a group of national scope to pirate our software.

We would rather avoid legal action if possible (though we won't preclude it) as we feel that this would not work to the benefit of the personal computing community. And obviously, what's done is already done. We suggest the following:

1. Immediate suspension of the distribution of CP/M User Group Volumes 13,20,21,26,27 containing our copyrighted software.
2. A signed statement from you affirming that no programs published at any time by Creative Computing will appear in the CP/M User's Group library without our prior written consent.
3. Notice of the above will appear in the next volume of the CP/M User's Group.

We feel that these demands are quite reasonable in view of the extreme nature of the violation of our rights, and hope you will see fit to comply. Our reason for taking this step is not because we have nothing better to do but that this may be seriously affecting our own sales of CP/M software. Frankly, we're tired of being ripped off and we intend to put a stop to it.

This matter will be turned over to our attorneys if we do not receive your written compliance with the above points by December 29, 1978.

Sincerely yours,

David H. Ahl
Publisher

Cure for TRS-80 Input Strangeness

Dear Editor:

In regard to the problem described in James Garson's letter in the Nov/Dec 1978 issue, the following routine may solve his problem:

```
10 CLS
20 IF PEEK (14340) THEN PRINT @ O, "THE R KEY IS
   DEPRESSED": GOTO 20 ELSE PRINT @ O, CHR$
   (30): GOTO 20
```

I feel the mark of a good computer programmer is his ability to find a subtle way of doing something that cannot be done directly.

Mark R. Cusumano
405 Covered Bridge Road
King of Prussia, PA 19406

Specifications:
S-100 compatible. MFM encoding, 35 tracks with ten 512-byte sectors per track. 179,200 bytes on double density SA-400 and North Star BASIC, DOS, and Monitor included.

For further information, write for full color catalog or contact your local computer store.

New from North Star

Double Density Performance at Single Density Prices

The new HORIZON computer and Micro Disk System now record in double density! That means each new Shugart SA-400 minifloppy disk drive accesses 180K bytes of on-line information. All double density HORIZON computers and Micro Disk Systems have a redesigned controller which allows the use of quadruple capacity disk drives as they become available in early 1979. A three-drive North Star System with quadruple capacity disk drives will access over a megabyte of on-line information. But, best of all there's no price increase for double density models.

North Star BASIC and DOS have been upgraded to accommodate the increased capacity and yet run existing programs with little or no change. The new disk system also supports single density, so existing single density diskettes can still be used. Single density SA-400 drives previously purchased with North Star systems can also be used.

Pricing

HORIZON with one double density SA-400 minifloppy (180K bytes), 16K RAM, Z80A processor and serial I/O port: $1599 kit, $1899 assembled.

MICRO DISK SYSTEM with one double density SA-400 minifloppy, controller board and power regulation: $699 kit, $799 assembled. (Cabinet and power supply $39 extra each.)

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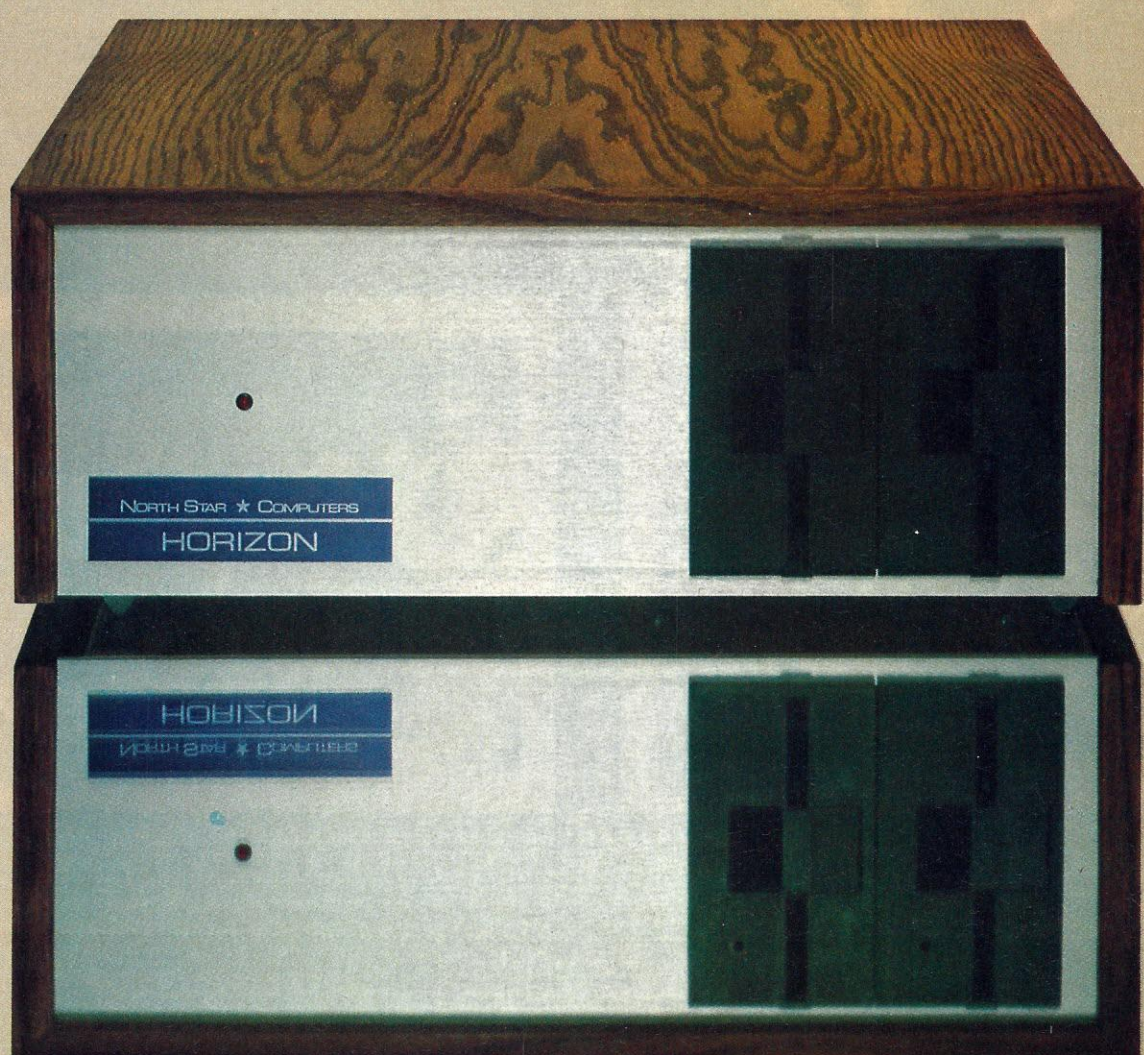
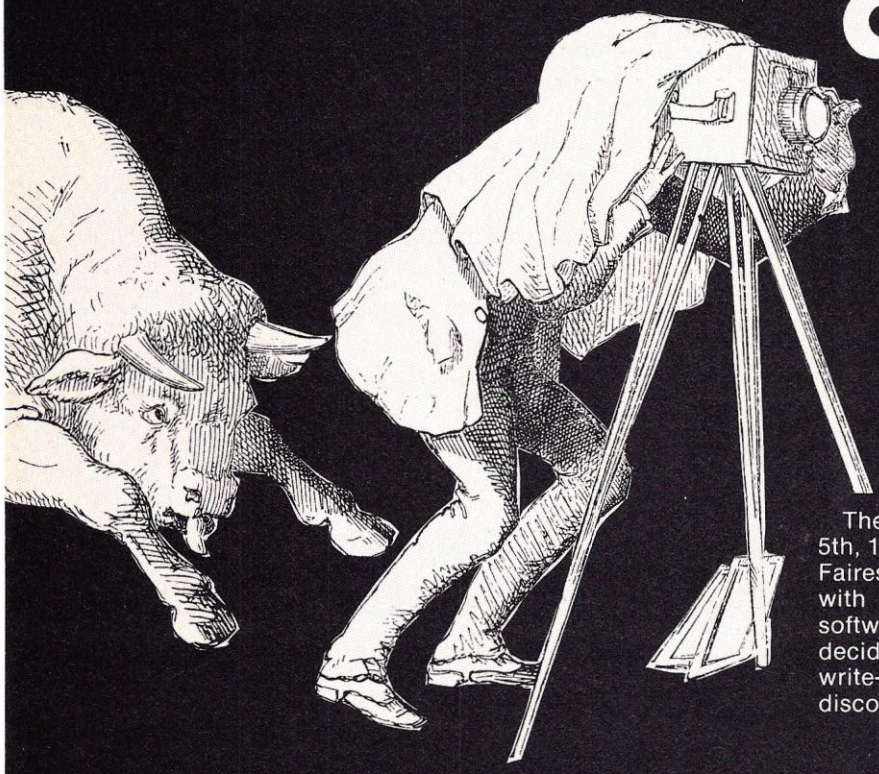


CIRCLE 163 ON READER SERVICE CARD

A glimpse at the faire

John Craig



the Software Show: 3rd West Coast Computer Faire

The 3rd Computer Faire, held in Los Angeles (Nov 2nd - 5th, 1978), was every bit as successful as the 1st and 2nd Faires ... and as enjoyable. I was particularly impressed with the large amount of software on display. Since software is the key to this entire industry, and may well decide whether we make it or not, I decided to devote my write-up of the show to that software ... and share my discoveries with you. ■

Bob Goodman, on the left, has developed a data base system, called Selector II, which runs under CBASIC or Microsoft BASIC and CP/M. We'll have a review of it in an upcoming issue. $255. Micro-Ap, 8939 San Ramon Rd., Dublin, CA 94566.

Why are all these people smiling? It's because the gentleman on the left, Gary Koffler, is giving them a fantastic demonstration of Appletalker and Apple-Lis'ner. He was playing a game of tic-tac-toe with the Apple (on a large-screen TV) using the voice synthesizer and voice recognition packages developed by Bob Bishop and Bill Depew. Impressive! If you've got an Apple... then send off for their catalog, by all means. Softape, 10756 Vanowen, No. Hollywood, CA 91605.

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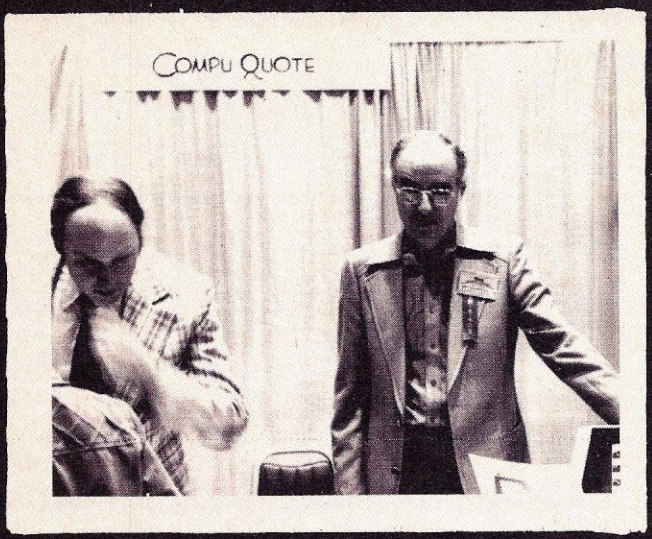
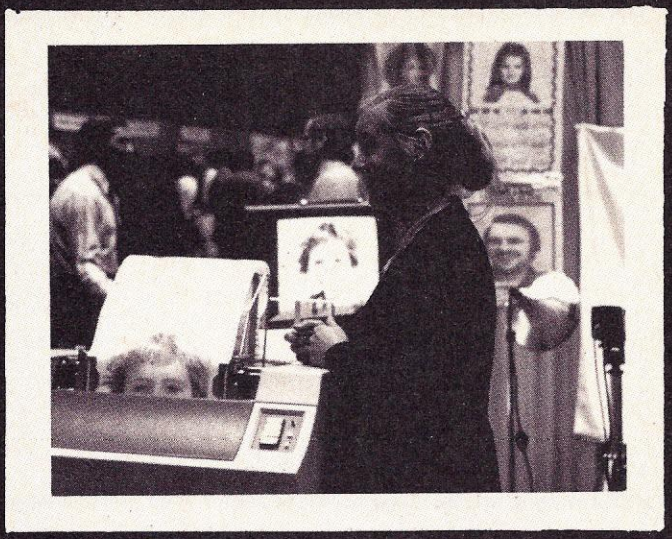
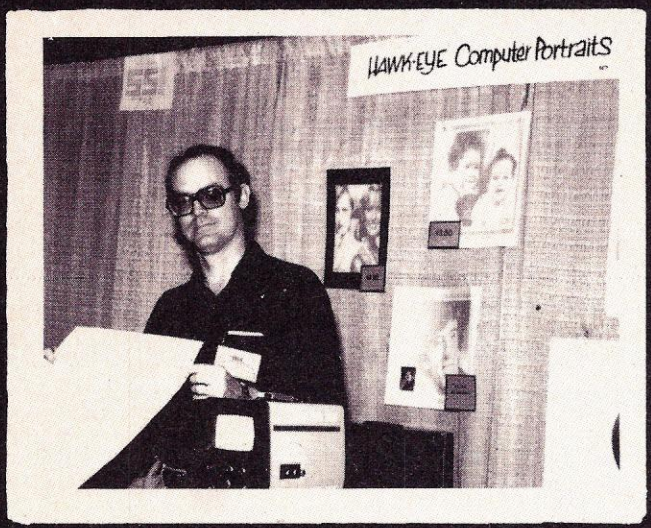


We've got a review of Compu-Quote's PET and TRS-80 checkers game coming up in Creative. Marvin Mallon (center) would love to receive your order for one. Be sure to include a check for $14.95. 6914 Berquist Ave., Canoga Park, CA 91307.

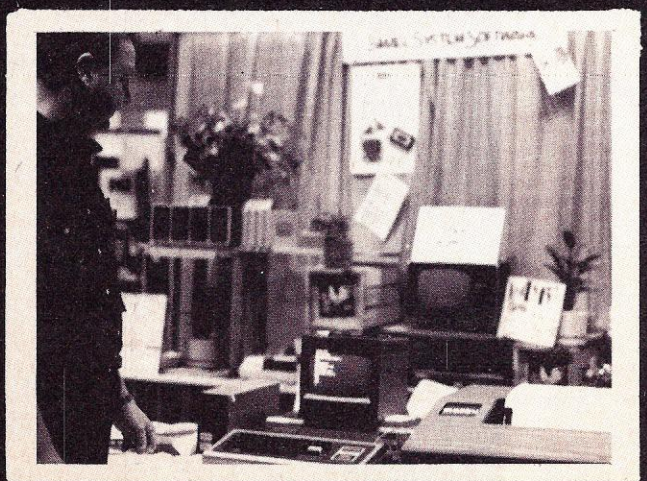


We're going to have an upcoming issue with reviews of several computer portrait systems (and other related computer-generated art). One of the systems we hope to cover is Computer Venture's system. Drop 'em a line for more info. PO Box 984, Action, MA 01720.



Another portrait system we hope to get an article on is this one owned by Don Eells (Hawkeye Computer Portraits). It can be purchased from COMPIC Corp., 113 N. Neil St., Champaigne, IL 61820.

Dr. Robert Goff is standing in the background and he, along with his partner Dr. Roger O. Littge, are offering an impressive (and significant) program called Home Poison Control. It runs under North Star DOS and sells for $28. A review of the package will be in the April issue. (They've also got a medical data base system, for $575, for doctors and/or hospitals which runs under CP/M and CBASIC.) Berkeley Medical Group, PO Box 5279, Berkeley, CA 94705.



Tom Nussmeier is looking over his disk-based TRS-80 system running RSM-2D, a monitor program for TRS-80 disk systems — $29.95 (they have a tape version also — $23.95). They sell Electric Pencil for the TRS-80 ($99.95) . . . which goes quite well with their TRS-232 printer interface ($39.95) and the Malibu Printer in the foreground (Malibu has a new enhanced character-generation scheme which comes very close to word processing quality . . . Malibu Design Group, 8900 Eton Ave., Suite G, Canoga Park, CA 91304). Tom's Small System Software also has a video game called Air Raid (for $14.95) which you don't want to buy . . . your machine will be tied up forever by people playing it! PO Box 366, Newbury Park, CA 91320.

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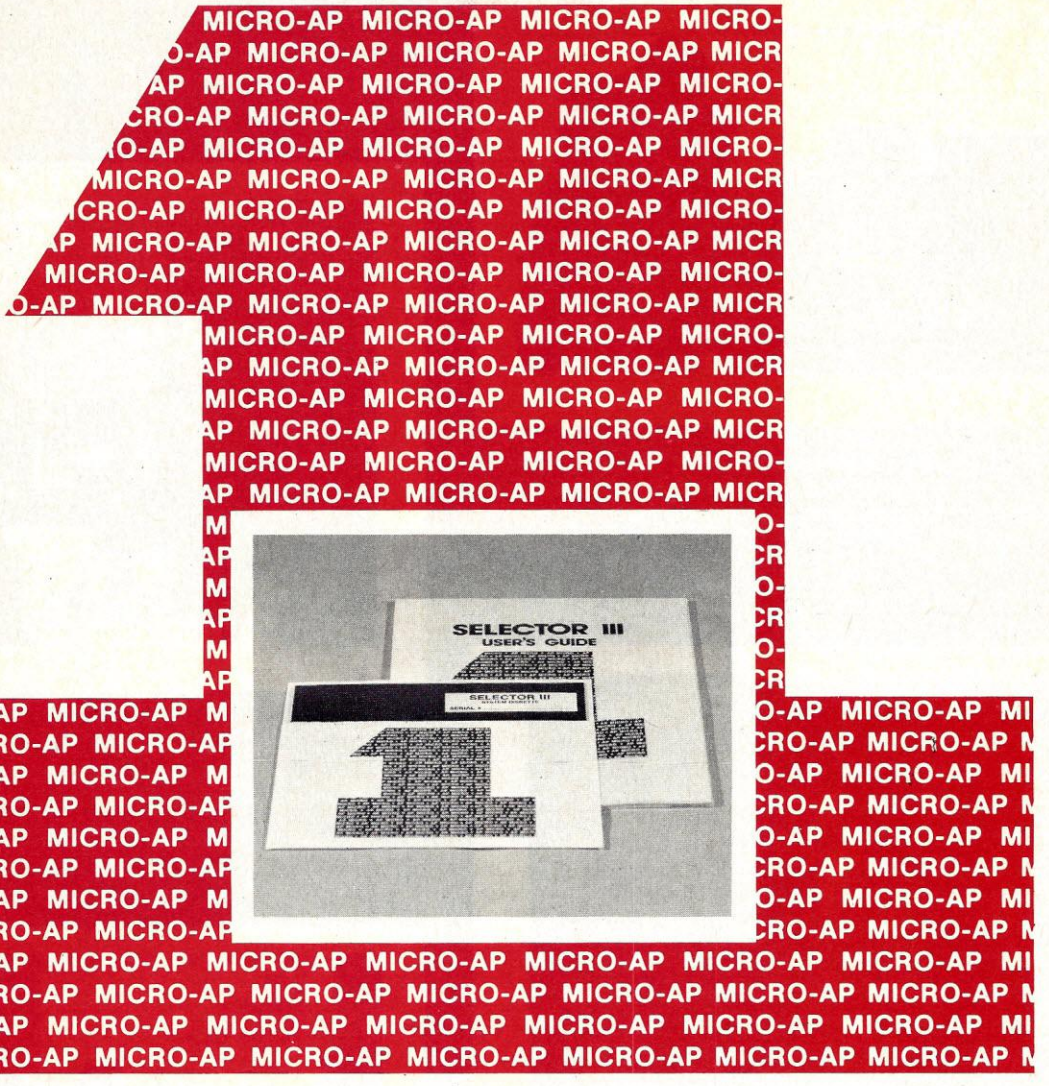

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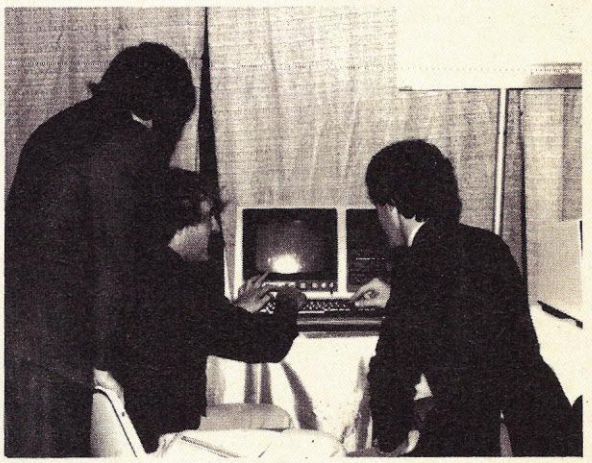
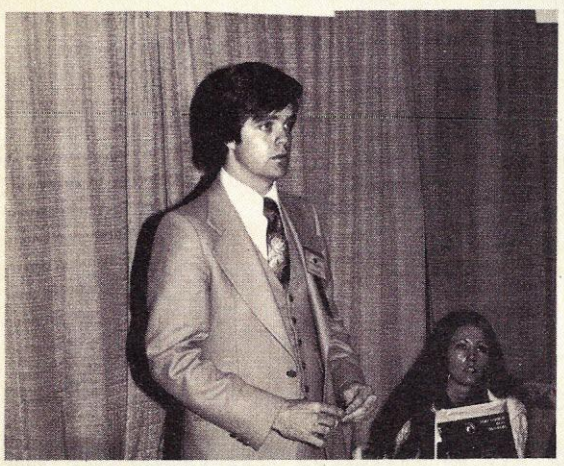
CIRCLE 127 ON READER SERVICE CARD

Digital Research (the folks who gave you CP/M) has CP/M up and running on ICOM's new 10 Megabyte hard disk. The gentleman in the photo is none other than John Pierce who will most likely be the one to help you with any problems called into Digital Research . . . and he's good at it! PO Box 579, Pacific Grove, CA 93950.



That's Fred Pood, Mkt-Mgr. for Micropro International Corp., demonstrating their Word-Master text editing system ($150). When put together with Super-Sort ($250) and Corresponder ($95) you come up with one heck of a word processing system. 5810 Commerce Blvd., Rohnert Park, CA 94928.



That handsome devil is Peter Burke, President of The BASIC Business Software Co., Inc. . . . and they have some software! Their packages run on the Alpha Micro AM-100, CP/M (CBASIC or Microsoft), TRS-80 Level II, Apple (and Pac #4 is also available for the Sorcerer). They have all of Osborne & Associates "Some Common Basic Programs" on diskette (for $22 w/o book, $30.50 with), Alpha-Micro utilities ($25), Statistic programs ($30) and Finance Calculator ($15). PO Box 2032, Salt Lake City, UT 84110.

Dick Milewski, on the left, is the man responsible for the high-quality software coming out of The Software Works (for North Star DOS systems) and for the Apple Cart column in Creative. His wife Mary, seated on the right, is responsible for that fantastic artwork . . . and the great cooking in the Milewski household! Dick's latest is "P/M Planner," a capital equipment inventory system with preventive maintenance scheduling ($149.95). Box 4386, Mountain View, CA 94040.

More faire photos on pages 78 - 79.

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Creative Builds the H-8

Alan B. Salisbury

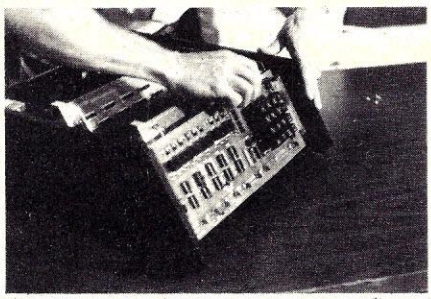
Earlier this year, we reported on the H-8 system (Creative Computing Jan/Feb 1978) based on using units assembled by Heath. Recently we built an H-8 system from kits. This article will focus on the kit building experience since the system performance was well covered in the earlier article.

The system we built consists of the CPU/Control Panel, 24K bytes of memory, and serial and parallel I/O interface boards. We added a cassette recorder and an H-9 terminal (wired) to exercise the system. All together, 9 separate kits were involved.

According to the Heath catalog, the H-8 is a "six evening" kit. If an evening is about 3 hours long, then that figure is reasonably accurate since about 16-18 hours should be adequate to put the basic H-8 together. (This came out to be more than six evenings for the author due to late dinners and young "helpers" to contend with.)

The first step in building a Heath kit is unpacking and organizing the materials. Our kit included the usual documentation and construction manuals, plus about six "special notices" or "important notices". Some of these contain important changes to the construction manual, parts substitution, and similar items. The builder might be more comfortable that he had everything he should have if one consolidated notice were included with each kit, or at least a key citing all the notices or changes that the purchaser should have. We recognize the publishing and distribution problems associated with volatile information, but the kit purchaser who makes a significant investment in Heath hardware is entitled to carefully controlled and updated documentation.

As with any kit an inventory of the parts should be accomplished. This is made easier for the inexperienced kit builder by the Heath practice of including within the manual illustrations of the many components. During this process it is also a good idea to organize the parts for easy retrieval during construction.



The control circuit board includes the keyboard which extends through the front panel.

The basic H-8 kit, it should be noted, does *not* include all the materials required to build a working computer. Significantly, no read-write memory (RAM) is included in this kit. At least one H8-1 memory kit must be assembled and installed before the H-8 can be checked out, let alone operated.

The H-8 consists of the power supply, mother board to accommodate up to ten other boards, front panel/control circuit board, and cabinet.

Also included (and packed separately) is the fully wired and pre-tested CPU board. This does not mean that there is very little circuit wiring to be done, however, since the control circuit board contains a great deal of circuitry. It is this board that gives the H-8 its "intelligent" front panel. In addition to the octal control function keyboard and octal LED readouts, the control board contains its own "program" in read-only memory (ROM) to enable it to perform its many control functions.

Assembly of the mother board and control circuit board is reasonably straight-forward and poses no difficulties if the instructions are followed carefully. In typical Heath fashion, the instructions are exceptionally well detailed and present virtually no confusion. Those not familiar with all of the parts involved must make use of the illustrations. The only potential problem we noted was with the tantalum capacitors. The printed polarity markings on our capacitors did not match up with the illustrations in the manual and were not well positioned on the parts. Following the guide in the manual might well result in reversed polarities and blown capacitors—fortunately not too expensive or difficult to obtain.

The novice kit builder would do well to practice soldering on spare boards (or the new Heath soldering kit) prior to beginning work on the real thing. Poor soldering is no doubt one of the most common causes of problems during construction, as well as later failures after the system has been in operation. A proper low wattage pencil type iron

is, of course, required and care must be taken to preclude cold solder joints or shorts due to excess solder.

Another area where great care is required is in the handling of some of the integrated circuits (IC's) which are exceptionally vulnerable to damage from electrostatic charge. Detailed instructions and caution notices are included.

A VTVM or similar instrument is required to make key measurements to check out the system during construction.

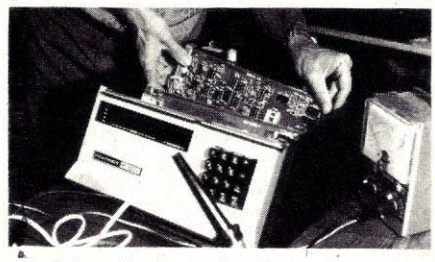
Much of the construction work on the H-8 is mechanical, involved with building the cabinet and front panel. The keyboard is composed of individual spring loaded keys which mount on the control circuit board and extend through an opening in the front panel. On our unit, the panel clearance around the keys was very tight resulting in some border keys occasionally getting stuck on the panel edge. Carefully trimming off the excess plastic on the edges of the key caps helped some, but did not completely cure the problem. We also have some concern about the long term reliability of the keyboard due to its lack of rugged construction. Other than this area, the overall cabinet construction is good, giving the unit a professional look and feel.

When the H-8 unit is finished, there is not much testing that can be done beyond some power supply measurements and visual checks. These are certainly recommended since they can catch many errors before they result in component damage. Operational checkout must await completion of at least one memory board.

Each H8-1 memory board can accommodate up to 8K bytes of memory. The kit includes only 4K, however, and a separate H8-3 kit (consisting of IC sockets and IC's only) is necessary to bring a board to its full 8K capacity. One evening should be sufficient to complete a memory board. The circuits are not very densely packed on the board, and the layout and component makeup permit a near assembly line approach. Compared to the control circuit board, memory boards are quite easy to build.

When the first memory board is finished and plugged into the H-8, an initial operational checkout can be accomplished. Heath provides a step-by-step sequence of instructions describing how to enter the first test program. If all has gone well in the construction to this point and the program is entered correctly, you will be rewarded with the message "Your H-8 is Up and Running" cleverly displayed on the LED's (which do not display regular alpha characters). Certainly this message is infinitely more rewarding to the kit builder than to the buyer who simply plugs in a prewired unit. A memory test routine is also provided along with information on "burning in" the unit to exercise it a bit more and perhaps uncover early failures.

The final phase of our construction project was the assembling of the serial and parallel interface boards. These are comparable in effort required to the control circuit board. The serial I/O and cassette interface board (H8-5) should be assembled first since it permits connecting both a cassette recorder and a terminal to the system. The parallel interface board (H8-2) will also handle the terminal, as well as other peripherals, handling a full byte at a time rather than a bit at a time as



Each board is plugged into the mother board as it is completed.

with the serial board. Connection of the cassette recorder and terminal permit full use of the system with the Heath provided software.

As we discussed, the instructions call for occasional checks to be made as the construction proceeds. The measurements called for require the availability of a voltmeter and ohmeter to check voltages and make simple continuity checks. A good digital voltmeter (DVM) or vacuum tube voltmeter (VTVM) is preferred.

When problems arise during these checks, the "In case of difficulty" tables provided in the manuals will start you on the road to tracking down the problem. Both symptoms and probable causes are included. When a particular component is cited as a possible cause of a problem, the builder can focus his attention on the indicated area of the circuit board, and perhaps substitute components where feasible. The average kit builder does not have the capability to completely check out a component.

Two sources of help may be available for resolving problems. For those fortunate enough to live near a Heath Electronics Center, technicians at these stores have generally been trained on these systems by Heath. In our case, the technician at a nearby center was both knowledgeable and helpful in pinpointing trouble areas for kit builders. Also, the Heath stores stock many parts and can generally replace defective or missing parts on the spot. This has an obvious advantage over mail order from Benton Harbor.

A source of help available to all is a hot-line phone number to the computer folks at Heath. During normal business hours (their time) you can call and discuss problems with an engineer or technician who may be able to talk you through a solution. As a last resort, the system can be sent to Heath, but this can be time consuming and expensive.

Is an H-8 kit right for you? Before making this decision you should decide whether the end product H-8 is what you want, regardless of whether or not you build it. This is a sophisticated system with considerable growth potential. Unlike some systems, it does not understand BASIC when the power is turned on. BASIC is just one of several programs that can be loaded. Others include an assembler, debug routine, and a text editor. Good documentation makes these relatively easy to use, but the documentation is not tutorial. In short, the H-8 is not for the casual hobbyist, but requires some knowledge of computer systems operation and software.

Will you learn a lot about computer systems and hardware from the building experience? Only if you make an extra effort. While the manuals are quite detailed about construction steps, they provide no explanatory information about the hardware functions along the way. Separate portions of the documentation explain system functions, but they are not tutorial either. Heath does, however, offer separate educational packages on computer hardware and software, although they are not targeted at the H-8.

As kits go, Heath is certainly the top of the line. Others don't come close in their quality of instructions and overall documentation. Support from the manufacturer also rates high. These are certainly important considerations.

All in all, we found building the H-8 to be an enjoyable experience. While not for everyone, H-8 kits offer a way to obtain a quality system with growth capabilities to satisfy the serious hobbyist or professional user. ■

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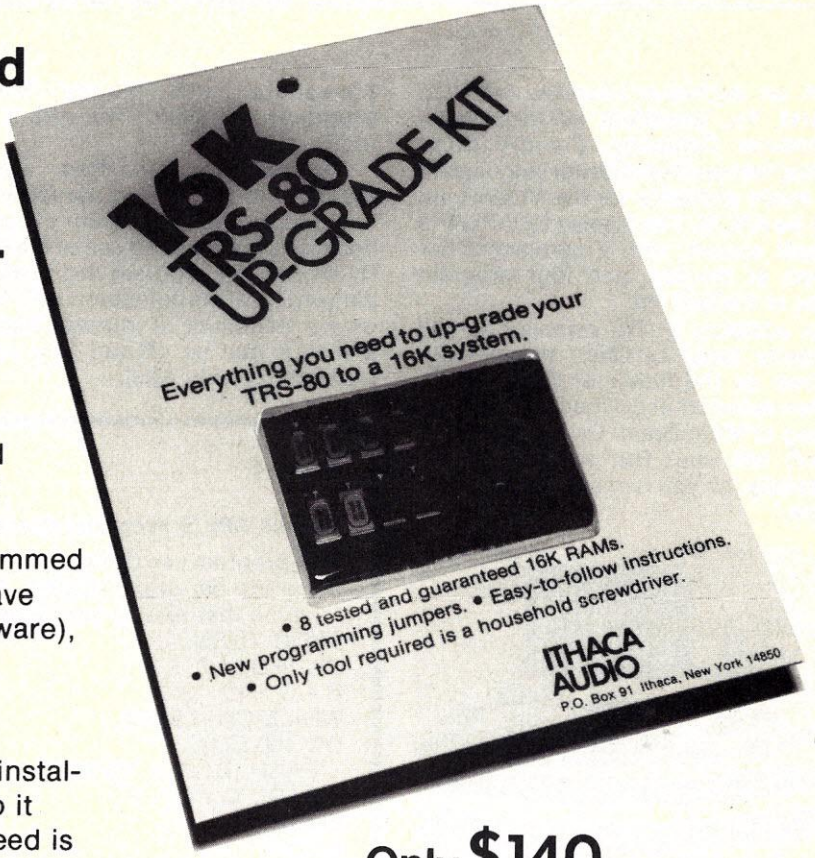
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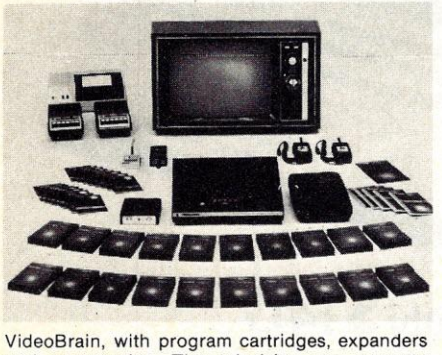
CIRCLE 109 ON READER SERVICE CARD

VideoBrain Uses APL/S

Stephen B. Gray

In an exclusive interview with Dr. Albert Yu, president of VideoBrain Computer Company, *Creative Computing* learned that the first language to be made available for the VideoBrain will be APL/S. The display for APL/S is a split screen, with a permanent bar graph at the top, and four program lines at the bottom.

In addition, Dr. Yu revealed he had recently hired Li Chen Wang, well-known as the father of Tiny BASIC. When asked what Li Chen Wang will be doing at VideoBrain, Dr. Yu replied, "I won't tell you. But software is his specialty, so you can extrapolate from there."



VideoBrain, with program cartridges, expanders and accessories. The television set, cassette recorders and printer are not supplied.

The Product

The product photograph shows 20 plug-in program cartridges, with APL/S, three financial programs, Timeshare, eight educational programs (Music Teacher, Wordwise, VideoArtist, etc.), and seven entertainment programs (Gladiator, Pinball, tennis, checkers, blackjack, ViceVersa, and Computer Life).

Three items shown are not supplied by VideoBrain: the television set, cassette recorder and printer. Optional hardware includes the two expanders, two joysticks, AC adapter and RF adapter. Packaged systems range from System 100 for $300, with VideoBrain, the RF and AC adapters, two joysticks, and the Financier program, to the top of the line, System 500, which includes all that System 100 offers, plus the two expanders, and the Timeshare and Money Minder programs, at $900. The APL/S cartridge is $150.

The plug-in cartridges contain programs in ROM, and are left in the VideoBrain during program execution because of continuing use of the ROM. By storing the program in an external plug-in ROM, the computer itself needs only a minimum of internal memory, and thus can be offered in a starter package for only $300.

Figure 1

Sample APL/S Program: Rotate Bars

This program can be used to demonstrate operation of the APL/S language, using the bar-graph display. The bars simulate a multi-colored hacksaw function that rotates bar-heights continuously.

```
PROG TURN
C = INDEX 7                          C contains 1, 2, 3, ... 7
B = C x 10                           B contains 10, 20, 30, ... 70
WHILE C(1) LE 100                    Start loop
DO 100 C(1)                          Display counter
  BARH (B = B + 10) MOD 130-65       Increment bars and display
  BARC C = C + 1                     Increment colors and display
ENDW                                 End loop
ENDP                                 End program
```

APL/S

According to the preprint provided by Dr. Yu on APL/S, it is a "combination of the array-manipulation capabilities of the powerful APL language and the structured control words of Pascal." The S in APL/S stands for "structured."

Not only does APL/S contain some Pascal, all the Greek characters have been removed. In fact, programs written in APL/S have little of the mystical appearance that APL presents to the uninitiated. Anyone familiar with BASIC should be able to understand APL/S with a minimum of difficulty.

APL/S uses commands such as LIST, SAVE and LOAD, editor commands including ERASE, NEXT, BACK (destructive backspace), statements such as BARH (controls bar-graph heights), IF, THEN, WHILE, DO, KEYB (keyboard read), two-argument functions that include AND, GE, LOG, OR, the five familiar signs, + - x ÷ *. and one-argument functions such as COS, EXP, NOT, SIGN. Look familiar?

The preprint explaining APL/S shows a lunar lander program, given first in APL/S and taking 29 lines, then in the BASIC program from which it was derived, the 90-line Lunar program from "101 BASIC Computer Games." (In the BASIC program, 31 of the 90 lines are REM and PRINT lines.) In another comparison, the BASIC program that computes internal rate of return takes 25 lines; in APL/S, 16 lines.

"APL has two camps," said Dr. Yu, "one of which loves it, the other hates it. APL/S will make the people who love APL, love it even more, and those who hate it will say, 'Gee, all my objections are removed.'"

"Our APL is different from normal APL. APL has some very strong points, and some glaring weaknesses. The strong point of APL is that it's a language with a tremendous amount of power, that it can manipulate arrays.

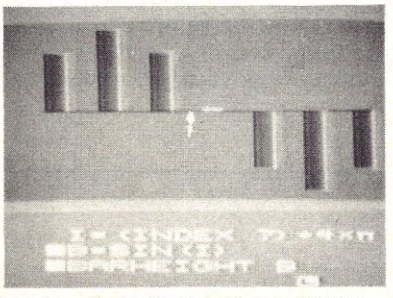
"APL has a lot of problems; for one, it uses Greek characters. We took them out, and use English. In a high-level language, the program is sort of like the way you talk, sort of like the way you think. That's the meaning of a high-level language. If you think along a logical sequence of events, and you

write them down exactly that way, and if you take a look at it, you can use the same code.

"Sure, BASIC is the de facto standard, no question about that. But there's also no question that people are looking for a higher-level language."

Your machine is perhaps more like a thinking man's computer? "That's right, because APL/S is a step or two above BASIC."

Will you have BASIC? "We have no plans to do BASIC. APL/S was first. I guess I'm not interested in just doing the same things as everybody else does. There's no advantage. Why would somebody buy our machine instead of somebody else's machine? We're thinking about BASIC. We're also thinking about Pilot. It's a fantastic educational language."



The unique display for VideoBrain's APL/S always shows a bar graph and up to four program lines. This program creates a sine wave.

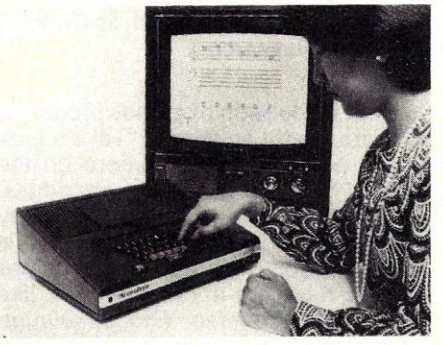
So you have one of the few machines that can use any language that a plug-in cartridge is available for, you and Sorcerer? "They may be the only other one. You just plug in whatever language you wish. You just slide in the APL/S cartridge, press down the lid. You enter the program at the bottom of the screen, and there's a bar graph at the top of the screen."

Is the bar graph always there? "Yes, the APL/S graphics is the bar graph. You can scroll up or down to look at any line in a program. The bar graph shows positive values above the horizontal line, negative values below. In 16 colors."

VideoBrain Color Graphics

Dr. Yu noted that the VideoBrain uses a custom chip for color graphics, and said "You need a lot of RAM for full resolution. What we wanted was a different way of generating graphics, without RAM. We use a two-chip replacement for RAM, and have patented this method, a more advanced form of character generator. It is the object method of generating color graphics, versus the standard dot-mapping. Here we define an object. Each bar in the graph is an object.

"In Music Teacher, the two clefs are stored in the ROM as objects. There are a total of 16 independent objects in Music Teacher. With the object method, we can provide color graphics at an affordable price. Also, we make it very easy to move items. Many color graphics are difficult to implement with other machines, but easy on the VideoBrain."



The Music Teacher program displays the "notes" you play, with the durations you use, and then plays back your tune. The program cartridge is plugged in under the lid at top center of VideoBrain.

The Two Expanders

Two expanders attach to the VideoBrain. Expander 1 provides an interface for cassette recorders and for RS-232C connection to printers, acoustic couplers and modems. Expander 2 is an acoustic coupler for using a telephone to communicate with other computers.

Speaking of Expander 1, Dr. Yu said, "This one interfaces with two audio cassettes that can record and play. Two audio cassettes instead of one. Single chips are so inexpensive, it's cost-effective to drive two cassettes; most computers drive only one. This expander has a 3870 microprocessor inside, making it an intelligent interface, to control two cassettes and two RS-232C ports, and to communicate with the VideoBrain."

When asked if Expander 2 would provide entry to a time-sharing system, Dr. Yu replied, "Yes. What you do is plug in the Timeshare cartridge. With that set up, what you basically do is turn the VideoBrain into a color terminal. This plug-in takes care of all the protocols, all the formulating." To connect to a time-sharing system, you need both Expanders 1 and 2, for two-way interaction.

Peripherals

Asked about a printer, Dr. Yu responded, "Since this is RS-232C, there's a whole bunch of printers available, such as Centronics. We haven't taken the responsibility of carrying one." Does this mean VideoBrain won't have a printer? "No, it just means that so far we haven't had the time to select a printer, but we will. We won't put the VideoBrain name on it, we'll just recommend one. Like the cassette recorders; we don't have our own recorders. We just recommend. This one from Radio Shack [mine, used for the interview] will work fine, Sears will work fine, also J.C. Penney, and Sanyo. The key is that you have to have the auxiliary input. For recording we use the AUX input instead of the mike; the impedance is different."

Asked about the possibility of providing disk, he answered, "I don't think we will. The reason is that to use disk you have to have a lot of memory. This machine is designed *not* to use a lot of memory, for cost reasons. In other words, we have a very specific cost objective in mind, and if you add a lot of memory, like 16K, 32K RAMs, the cost becomes unreasonably high. And with a disk memory, you're definitely talking about a system over $1,500. We want to be below the $1,000 price point. So that's why, at this point, we preclude the use of disk and lots of memory. As time goes on, who knows? I think disk price will come down, volume will go up. Memory prices will continue to come down."

Manufacture

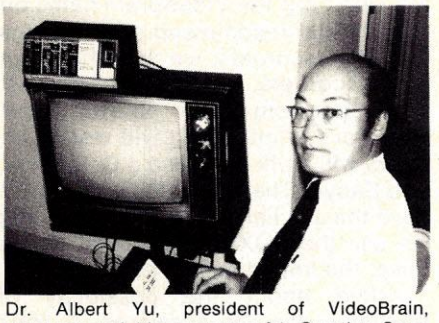
Is the VideoBrain made in this country? "Yes, in Santa Clara, California. Most of the parts are purchased in the United States. There's only one piece here that's made in Hong Kong, the cartridge mechanism, and it's very similar to a cassette mechanism. In Hong Kong, they have a huge volume, and much experience. All the LSI is bought here, the TTL, PC board, plastic case, all bought here. With the dollar going down, to manufacture over there would be very tough."

The F8 Microprocessor

Asked why he chose the F8 for the VideoBrain, Dr. Yu replied, "Primarily because of the low cost, and we don't need a super-high-speed processor. We could easily use any other processor. But when we made the decision, it was between the 8080 and the F8. The Z80 wasn't available in time, nor the 6800. So the F8 was chosen, primarily because of cost. The 8080 would take a lot more component count. The 3870 in the Expander 1 is really an F8 kind of machine, except it's on one chip, and uses the same instruction set as the F8."

Umtech and VideoBrain

What is the difference between Umtech and VideoBrain? "They're the same company. When we formed the company, that was before the VideoBrain name was coined. So Umtech was the original name. A lot of people ask me what it stands for. It's for Universal Microcomputer Technology.



Dr. Albert Yu, president of VideoBrain, demonstrated his computer for Creative Computing in a New York hotel room, equipped with Home Box Office on the TV set.

We were interested in a microcomputer system. Why didn't we use the Umtech name on the computer? It doesn't sound right, it doesn't mean anything. We chose the Umtech name because at the time it wasn't clear exactly what direction we were going to take. VideoBrain was coined after we talked about home-computer concepts. We wanted a name very easy to remember, very descriptive."

Who founded Umtech? "Myself and Dave Chung." According to the press release, Dr. David Chung, with a PhD in EE from Purdue, invented the F8 while at Fairchild, and directed the F8 program there, as General Manager of R&D. Dr. Albert Yu, with a PhD in EE from Stanford, directed Technology and Product Development at Intel, and was previously at Fairchild, as Director of Device Research.

Software

What is the ratio of games programs to more useful software? "Take a look at the pile of cartridges here on the table. There are five game cartridges, six educational, and three money managers. What we're trying to do is have a balance in software. The games that we have are thinking games, like checkers, ViceVersa, and simulation games. We have one or two like Pong, but that's not a very useful use of a computer.

"There are two things I'm personally addicted to. One is the APL/S language that we just introduced, which is really a powerful high-level language. The other is ViceVersa, which is a computer game, with five levels of difficulty. It's very much like Othello, sort of like Go, a simplified version of Go. You surround the enemies and you flip their pieces, they become yours. The reason I'm addicted to it is because I can't beat the highest level yet. That's the challenge there."

Service

Asked about service, Dr. Yu said, "VideoBrain handles all the service right now. This is a brand-new product, and we need to know what the problems are, as we can't predict what they will be. Next year, in 1979, we will set up regional centers. This is very much a psychological thing, because people don't want to send something to California for fixing, it's like sending it to a foreign country, not like sending it to nearby New Jersey, for example."■

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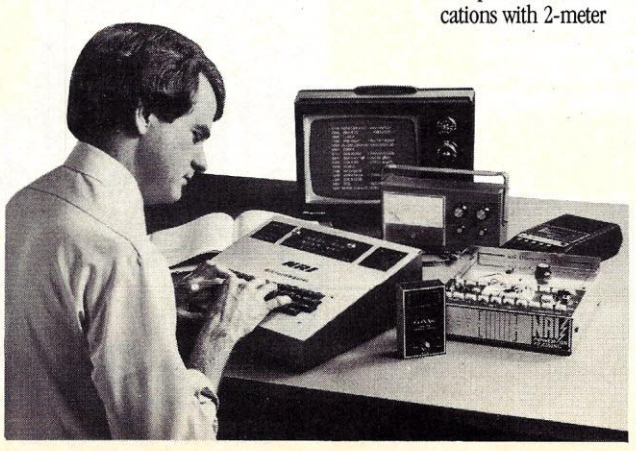

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CIRCLE 206 ON READER SERVICE CARD

Technology Marches On: Thinker Toys' Floppy Disk System

Does a floppy disk have to be complicated? George Morrow doesn't think so and proved it with the design for his Disk Jockey controller board.

Ockham's Razor:
Entia non sunt multiplicanda praeter necessitatem.
(Entities are not to be multiplied without necessity.)
William of Ockham
14th Century English Philosopher

How, you ask, does this admonition of a 14th century philosopher apply to the design of a 20th century floppy disk system? While the link may at first seem obscure, I assure you it is not. Permit me to draw the two together.

Floppy disk controllers have always seemed to me to be overly complicated. Take for example, the controller I have used for quite some time with my 8080 system. It consists of two rather large printed circuit boards containing more than 200 integrated circuits. In addition, there are 25 or so chips on an S-100 interface board.

Dick Whipple, 305 Clemson Dr., Tyler, TX 75703.

Imagine my perplexity several months ago when one of those 200 assorted IC's failed and I had to troubleshoot the circuit. As I poured over the pages of schematics, I kept thinking surely all these chips aren't necessary. I did remember being told once that the 8080 was not fast enough to handle the disk I/O — you just had to have TTL speed. I was also aware that LSI controller chips like the Western Digital 1771 could cut the chip count by 75% but even with the simplified design, the 8080 still had to sit back and wait for the disk I/O to be performed. I kept wondering if there might not be a more intelligent approach that would use the 8080 to advantage. What I wished was that some creative designer would take Ockham's Razor to floppy disk controllers and cut them down to size.

As you might well have guessed, that is just what has been done. I am pleased to report that the people at Thinker Toys have put together a brilliant piece of design they call the DISK JOCKEY. It consists of a single S-100 board with 35 TTL IC's. There is no LSI controller anywhere to be found! The "slow poke" 8080 does Direct Memory Access (DMA) and completely controls disk operation. If that's not a clean shave with Ockham's Razor, pray tell what is!*

Although full elaboration on the DISK JOCKEY's theory of operation is not possible here, a brief description will in order. Data is stored on a floppy disk in serial form; i.e., bit following bit to form an 8 bit byte; byte following byte to form a 128 byte sector; sector following sector to form a 26 sector track; and finally track concentrically following track to form a 77 track floopy disk.** Once the read/write head is positioned over the selected track and sector, the revolving disk sends a serial stream of bits that must be captured 8 bits at a time and processed for storage in memory. The similarity to a standard serial I/O terminal might suggest that a UART, status port, and data port be used to perform disk I/O. A problem arises however; the 8080 program required to service such a hardware arrangement does not execute fast enough to keep up with the data being collected by the UART. Conventional designs get around this limitation by maintaining a separate 128 byte memory in the external controller to buffer disk data. The 8080 can then process data in and out of this buffer at a more leisurely pace.

The DISK JOCKEY takes an entirely different approach. Suppose the 8080 disk I/O routines could be simplified and their execution time reduced to a point which would allow the processing of data directly on the disk. The key to such a design would be a method (other than use of a status port) to synchronize data transfer between the 8080 and the disk. A technique to accomplish this was suggested by Eugene Fisher in a November 8, 1975 issue of *Electronics Design Magazine*. Mr. Fisher proposed a novel use of the 8080 READY line to achieve synchronization. His idea has since been incorporated into the DISK JOCKEY. Disk control, status and data are transferred between the processor and the controller using memory mapped I/O; that is, certain addresses in the 8080's memory space are set aside to be used as input or output ports. 8080 store and load instructions (like STAX D and LDAX D) are then used to transfer data. Whenever one of the special disk I/O addresses is accessed, circuitry in the DISK JOCKEY pulls the READY line low causing the 8080 to enter a WAIT state. The READY line is released only when the controller and disk are indeed "ready" for byte transfer, thus assuring that processor execution remains synchronized with the disk. Using this approach, the disk I/O routines are simplified and execution time reduced sufficiently to permit the 8080 to assume all functions as disk controller. A direct benefit of this design is that the 128 byte memory buffer no longer has to be separate but can be a part of the 8080's normal address space. This means that when you get ready to do disk I/O you simply point to the first of the 128 byte block to be read or written and zip — transfer takes place at the maximum data rate of the disk. In effect, the DISK JOCKEY performs Direct Memory Access or DMA as it is called. Of course, all disk read/write operations are done with full CRC error checking to insure reliable data storage.

CLOSEUP OF DISCUS DISKETTE DRIVE shows the complete assembled drive, cabinet containing power supply and power switch, all available completely tested from THINKER TOYS (Morrow).

The address space of the DISK JOCKEY covers a 1000 byte region and includes a 512 byte program ROM, a 256 byte scratch RAM, and 256 byte area reserved for I/O registers. Disk I/O can be accomplished by writing your own routines or more simply by using the ones provided on the ROM. In summary, those on ROM include:

TRKSET Performs a seek operation to the track number specified on the 8080's C register.

SECTOR Sets up the sector number specified in the C register for access.

DMA Establishes the address of the 128 byte block of memory to be the source or destination for disk data transfer.

READ Reads the selected track and sector storing the data in the memory block specified by the DMA address.

WRITE Writes the block of data at the DMA address to the selected track and sector of the disk.

TRZERO Moves the read/write head to track 0.

DBOOT Loads and executes a bootstrap routine on the disk in drive A.

The DISK JOCKEY also provides an input/output port for use with a serial RS-232 or current loop terminal. The ROM contains two additional routines (TERMIN and TEROUT) to service this port. Serial I/O is actually performed with a software simulation of a UART using only a one bit port. The baud rate is determined by a timing constant stored in DISK JOCKEY RAM. Though

*If the point about Ockham's Razor is still not clear, consider a slight rewording: Ockham's Razor (as modified for intelligent digital design) IC's are not to be multiplied without necessity.

this method does not make the most efficient use of the processor, it is a simple and direct way to implement a serial port.

The DISK JOCKEY can be used with a wide variety of floppy disk drives. On board switches permit selection of either 5 or 8 inch models. It can also be purchased as part of a complete disk system called the DISCUS I. In addition to the DISK JOCKEY controller, the DISCUS I package includes a Shugart SA-800R (8 inch) drive, power supply, connecting cables and a selection of software.

The Shugart drive has an excellent reputation. The solid cast aluminum frame is impressive. Some other drives use only a medium gauge metal chassis that is subject to warping and subsequent head misalignment. The drive and its power supply are housed in a blue wrap-around case. I was a little surprised that there was no cooling fan, but apparently one is not required. The drive has a write-protect feature and a "busy" light on front.

Memory Mapped DISCUS controller uses unique approach to transfer data at high speed without the high parts count and complexity of DMA or interrupt driven devices. Modifications shown are for the "SIMPLE COMPUTER" described in the March, 1978 issue of Kilobaud Magazine.

With the purchase of a DISCUS I, the user receives a software package called Dist ATE (Assembler/Text Editor). Author David Fitts has endowed Disk ATE with several interesting and in some cases unique features. The text editor is extremely versatile, imposing few restrictions on the content of files. ASCII text or machine code can be handled with equal facility. Complicated and repetitive editing tasks can be accomplished using a programmed execution capability. The user can even incorporate these command strings or "edit macros" into Disk ATE by adding them to a symbol table. One feature I particularly like is the ability to select the number base to be used in the editor and assembler. As a fan of octal, all I have to do is enter the command B8 and all output will be in split octal.

I will take exception to one statement made in the ATE user's guide. It is suggested the ATE is "easy" to learn and use. While I am impressed with what ATE will do, setting up the command strings for a particular task cannot be passed off as trivial. I found that considerable experimentation was often necessary to fully understand the capabilities of ATE. Like most truly powerful programming tools, full appreciation comes only after extensive use. Frankly, no text editor can be called easy to learn or use, unless it utilizes the visual properties of a CRT screen completely — ATE does not.

Purchasers of DISCUS I are also eligible to receive a DISK BASIC although it is not ready for distribution at this time. For additional cost, a specially configured version of CP/M can be purchased along with compatible software packages such as ANSI-standard FORTRAN. I have adopted my personally authored BASIC (Disk BASIC ETC) to run with the DISCUS I and have found the results impressive. Storage and retrieval speed for both programs and data has nearly doubled over my original disk configuration. TABLE 1 presents timings for several disk exercises using BASIC ETC with the DISCUS I.

TABLE I

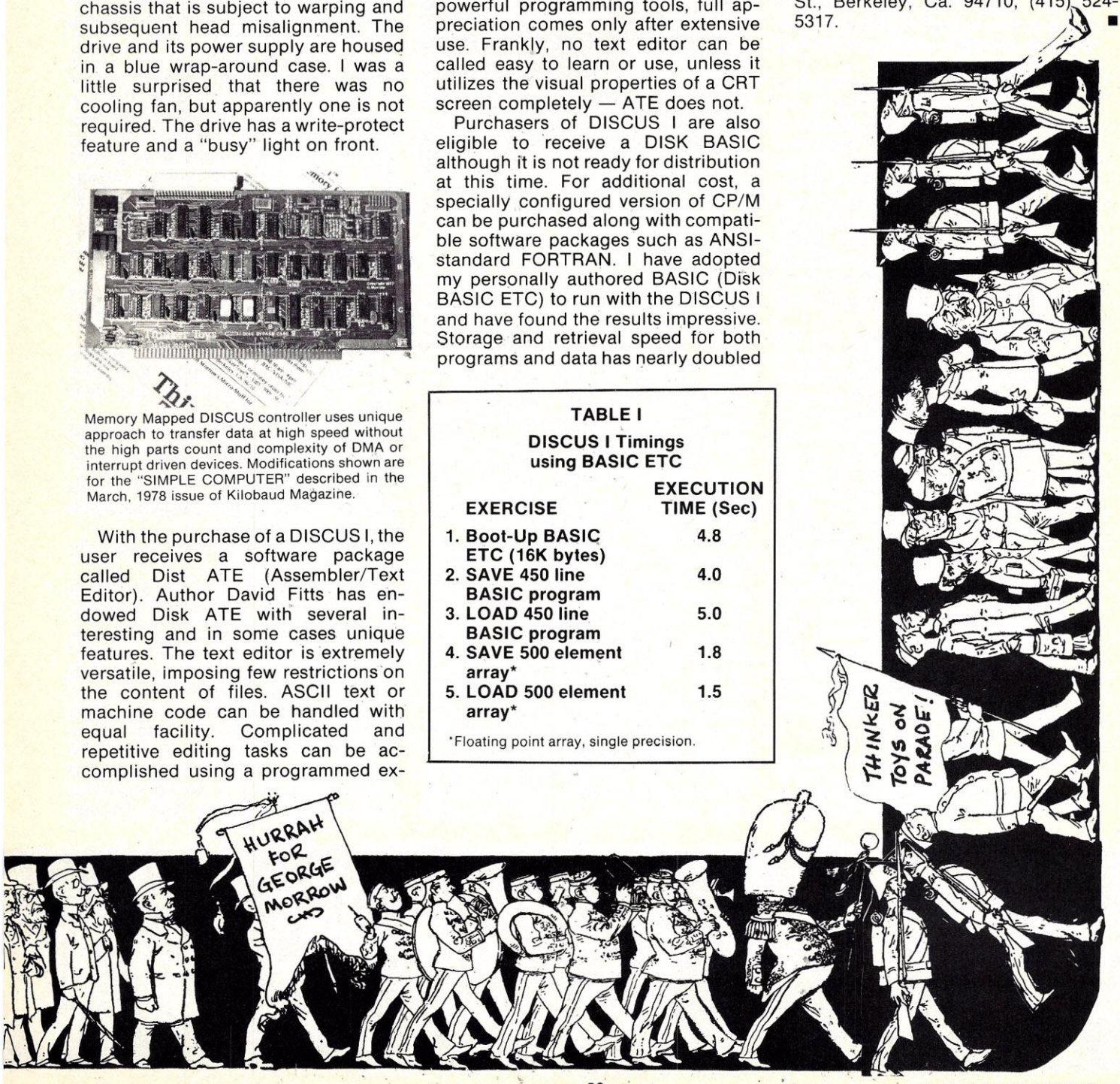
DISCUS I Timings using BASIC ETC

EXERCISE	EXECUTION TIME (Sec)
1. Boot-Up BASIC ETC (16K bytes)	4.8
2. SAVE 450 line BASIC program	4.0
3. LOAD 450 line BASIC program	5.0
4. SAVE 500 element array*	1.8
5. LOAD 500 element array*	1.5

*Floating point array, single precision.

The DISK JOCKEY can be purchased separately for $214 assembled and tested, or $179 as a kit. The complete DISCUS I retails for $995 (one drive) or $1,790 (two drives) which makes it one of the least expensive full 8 inch floppy disk systems on the market. The people at Thinker Toys are to be congratulated for a fine design achievement. In the future, perhaps we will see Ockham's Razor applied successfully to other microprocessor subsystems.

To obtain further information about the DISK JOCKEY or DISCUS I you may contact: Thinker Toys, 1201 10th St., Berkeley, Ca. 94710, (415) 524-5317. ■



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Interview With Michael Shrayer

In the following interview, David Ahl, publisher of Creative Computing discusses the word processing system, Electric Pencil, with its author, Michael Shrayer.

DA: Michael, you're probably best known for a piece of software called Electric Pencil, which is one of the first word processing systems for microcomputers. Why don't you tell us a little bit about it and what was on your mind when you first designed it, who was it designed for, what kind of environment did you anticipate it being used in?

MS: Well, I put the Pencil together because I had a need for a word processor/text editor for myself. I had just completed what I considered a major piece of software (an operating system executive) and it required a rather extensive manual. I didn't have anything to use for writing it so I developed Electric Pencil.

DA: Was it originally written for the SOL, or some other computer?

MS: Oh, I got one of the first Altairs in the LA area and I still use that although I've obtained 5 or 6 additional systems since. My basic program development system is the Altair and the first Pencil was written for it and the Processor Tech VDM-1 board I had just acquired. I decided on using a memory mapped video (the VDM-1) because of the flexibility it allowed insofar as accessing text and shifting it around on the screen. It seemed to be considerably more powerful than a straight computer terminal.

DA: Now you've modified or extended Electric Pencil to run on a variety of machines, right?

MS: That's true. We have over 40 versions currently and the number is growing. Soon it will be about 46. The thing I find kind of interesting is that it comes very close to meeting most people's needs with very little modification.

DA: You said you originally designed it because you were writing a fairly long manual. On the other hand, you're saying it fits the requirements of a lot of people. Does it fit the requirements of a secretary writing a letter and does she learn to use it easily?

MS: Right, very easily. We find that people who don't know anything about computers seem to pick it up in a couple of hours. Within a few days they're quite proficient at it. The interesting thing is that it uses the standard keyboard. We originally wanted to design new keyboards with additional characters so that people would not have to use control characters as they do now. But in talking to actual users, they preferred having a standard keyboard rather than learning a new one.

DA: Which version is the most popular?

MS: As soon as we come up with a new version it seems to be the biggest seller but I think we've sold more of the SOL than anything else.

DA: Where do you see it going from here? What's the future for Electric Pencil and, more importantly, what's the future for Michael Schrayer Software?

MS: I think I'd like to get onto other projects but it doesn't seem that I'm going to be able to because of the constant upgrading and modifying and changing the Pencil. We're going to be coming out with some utility programs and we're trying to make Pencil more applicable for CP/M usage. A few months ago I stopped and realized that I could be writing Electric Pencil for the rest of my life because it seems to be the kind of program that people can understand and relate to; it seems to be a practical program. A good friend of mine was telling me that he couldn't convince his wife of a practical use for a computer. When she saw Electric Pencil she said, "That's the first practical use I've seen for a computer."

DA: And, what would she do with it?

MS: Oh, just type letters. Anybody who has anything to do with putting ideas down on paper has a use for Pencil. I've received letters from radio amateurs that use it for their log keeping because they can use the powerful search routines in Pencil to search for the different stations they worked previously (by date, or by station, or by country).

DA: We found in a recent readership survey that text-editing/word-processing is number two in applications that people wanted to do with their own computer. My guess is that Electric Pencil would have to be one of the biggest selling word processing systems for micros. Who are your competitors?

MS: Well, actually we don't have any competitors, interestingly enough. None that I know of, anyway.

DA: I know some of the computer stores, like the Byte shops, have a similar version of a text editing system and MIT has a word processor.

MS: Yeah, well, I don't really consider them competitors because, first of all, MIT's system is $1800. So you know they're in a different league than we are. It's not a character oriented processor, it's a line oriented processor.

DA: You mentioned a moment ago that you could be doing this for the rest of your life. Would you prefer to be doing some other things? Are there other things in software, or other things altogether, that you'd like to do?

MS: Well, I've got some experimental ideas in software that I'd like to play with. Insofar as practical usages for them, I haven't really determined what they are. Just ideas and concepts in software that I would like to play with,

other languages I'd like to play with. However, it's not like I've got some urgent project or application piece of software that I'd like to write. There are just things that I'd like to play with and just get back to enjoying the thing a little more as I did when I first got into it. Now it's pretty much as a business and the projects and software development for specific usages, as opposed to just playing around, is not what got me into this thing originally. I was a film director for 20 years and this is a totally new field for me. I just picked this up in '75 and the interesting thing is that there is a tremendous analogy between writing software and producing motion pictures. It's very much like when a film gets into its editing stage. That's pretty much what a piece of software is like in that you're shifting routines around, shifting ideas around, developing a basic design philosophy for a piece of software and carrying it through to fruition and seeing the product.

DA: How do you feel about the interaction between the user and computer?

MS: It's that interaction, the interface between the computer and the human, that's important. That's the specific thing that I've received the most comments on about my software. One of the most important things is to have a polite computer. It seems that many newcomers in writing software seem to make the computer overpower the human and people resent it for some reason or another. I never do that and I don't like having the computer come back with smart-ass remarks. To me it's very sophomoric and not the way to present computers to a general audience. It's kind of cute around campus but I'm against it. I could spend, for example, 2 weeks on how something would look on the screen. Just a layout of the table, for example, to make the lines come out even and stuff like that. It's fortunate for me because I can do that. If I had a big company I could never imagine spending 2 weeks on something like that. I think it's these little touches that people find interesting or different about my particular software. I frankly think that someday computer programs will be like works of art and people will look at them like that and basically just by the quality that's been put into the programs. I like classy programs and you don't see too many of them. From my background you can see where I can get into that kind of thing. The art of it. I find that to be my guiding light.

DA: Well, thank you. I appreciate your time.

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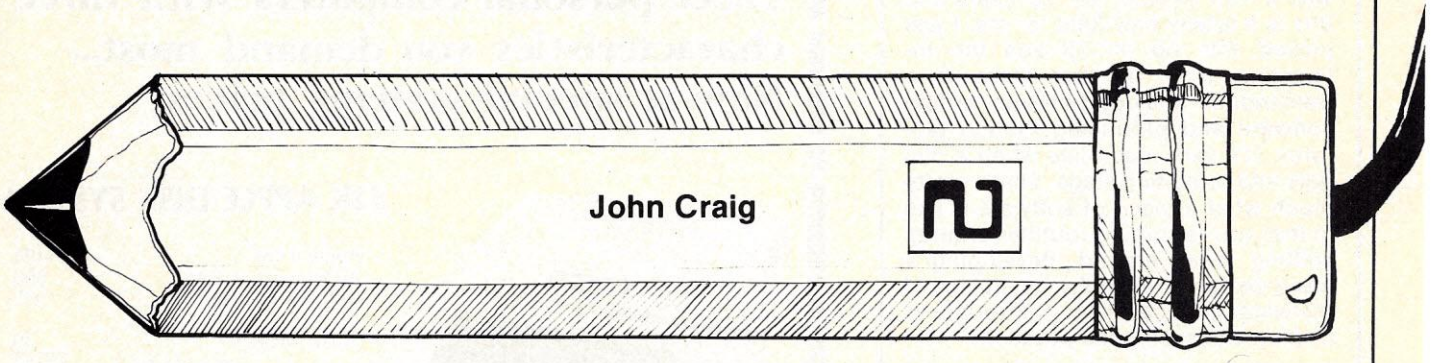


John Craig

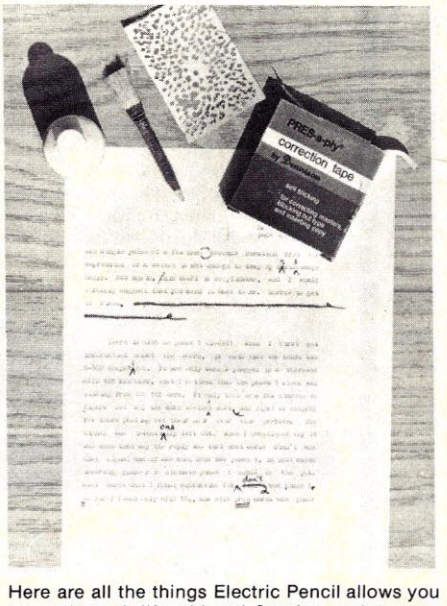
Several days ago my 17 year-old daughter, Tracy, mentioned that she had a term paper which needed typing and asked if she could use my typewriter. I said she was more than welcome to it ... but that she really ought to write the report using Electric Pencil. I did a good selling job and convinced her of the advantages. A few hours ago she dropped in and proceeded to sweet talk me into letting her have the system because this was the night before the report was due! (She definitely has some of her Dad's "procrastinating blood" in her!)

There are a couple of significant points about this little story. Tracy spent approximately 4 hours typing a 6-page report. Now, that may seem like a long time but I can remember her doing the same thing in the past, with the typewriter, and taking much longer. She was thoroughly sold on using Pencil at the end of those four hours ... and you should have seen the smile when her masterpiece started coming out of the printer! I would be willing to bet that if every home had a word processing system it would get more than its share of use.

My daughter had never used Electric Pencil before sitting down to do that report. With a minimum amount of instruction from me she entered, *and corrected*, all of that text on her own! The system is easy to use ... and I can't think of a better testimonial than what I've just given you. (Heck, I think she learned it faster than I did!)

Why Pencil?

I've got a perfectly good electric typewriter sitting across the room but I hardly ever use it for writing anything ... especially an article such as this!



Here are all the things Electric Pencil allows you to go through life without! Starting at the upper left, and going clockwise, you can begin by throwing away all your bottles of correction fluid (and the thinner your kids have probably been sniffing!). next, get rid of those erasures ... who needs 'em? (With Pencil your mistakes are never seen!) I've got a good supply of Ko-Rec-Type (tm) typewriter opaquing film that I'd like to sell cheap. It's really great stuff if you use a typewriter! Heck, I'll throw in a few boxes of correction tape ... just to sweeten the deal! And, finally, you can get rid of pages of typewritten material that has to be edited ... and then retyped!

Stop and consider for a moment some of the writing you've done in the past ... anything, even a short letter to your Aunt Matilda. If you used a pencil for that letter I'd be willing to bet you had to use an eraser once or twice. If you used a typewriter I'd almost guarantee there were some errors made which needed correction. I used to do all my writing (correspondence, editorials, articles, etc.) using a typwriter ... so I know! I know there isn't any comparison to using a good word processing system for those things. When I make a typing mistake now (and, believe me, I've made plenty in just these first few paragraphs) I don't have to get out the correction fluid, or use the highly sophisticated"overstrike" technique, or get the correction tape out. No, all I have to do is hit the "Delete" key on this keyboard, which backs the cursor up to the mistake, and retype! At the risk of sounding too over-enthusiastic, I honestly feel the use of a good word processing system (and Electric Pencil in particular) will open up a whole new dimension for any writer.

Some of the Features

Let me just recap a couple of the points made in the last paragraphs. If I was writing this article the old way (i.e., using my electric typewriter) I would have, at this point, a piece of paper filled with words and several places where correction fluid or tape had been used. If, after looking the mess over, I decided that certain

words, sentences, or paragraphs needed changing or deleting I would have to get out my red pencil and do some editing. Needless to say, the page would have to be re-typed ... and, very likely, require further editing! Even at this point in writing this article (with Electric Pencil) I've gone back to several sentences and made changes. But, most importantly, there aren't any misspelled words (because I usually catch them as I'm typing). When this thing is dumped out on my printer it'll be finished!

Just to give you an idea of the number of features available with Pencil I'll point out that all 26 letters of the alphabet are used as control characters for the various commands and functions. Following are descriptions of some of those commands and functions.

Cursor control—A Control W, A, S and Z are used for moving the cursor UP, LEFT, RIGHT and DOWN, respectively. Take a look at a typewriter or keyboard and you'll see how that combination of letters lends itself to the task quite well. A Control Q puts the cursor in the home position (upper left), a Control B puts it at the beginning of the text buffer and a Control N is used for going to the end. There are also control characters for doing line feed, form feed, tab and carriage returns.

Insertion & Deletions—Electric Pencil is a character-oriented system which means that characters can be inserted and deleted ... almost as easily as they're originally entered. For example, if I misspelled the word "mispelled" I would simply back the cursor up (assuming I caught it while typing), using a Control A, until it was over the first "s." I would then type a Control F, to put me in the character insertion mode and type an "s." Then the magic takes over and misspelled suddenly has two "s's" ... like it's supposed to! The magic is much more impressive when it comes to inserting one or more words, or even sentences, and the text is pushed off the line, on the right, and placed on the next line below. In that last sentence I wrote "off of the line" the first time around ... and decided "of" should go. To accomplish that I backed the cursor up until it was over the "o" and hit a Control D (for character detele) three times to eliminate the two letters and one space. Nice, huh? I certainly think so! Pencil also has the capability of inserting deeleting or moving entire lines or paragraphs ... which, aside from being quite handy, is very impressive to watch! For example, in the original draft of this article the first two or three paragraphs about my daughter were buried in the middle of the article. I decided that I would like to have them as the introduction. Using the block move feature I very simply moved them to the beginning ... and then deleted (using block delete) what had been there originally plus the new paragraphs from where they had been before.

Scrolling—Here's another area where the showmanship running through Michael Shrayer's veins becomes evident. (And that flair and style shows up in many places!) A Control E will cause the screen to scroll up ... and typing a number, from 1 to 9, will vary the speed of the scrolling (fastest with a 1 and a page at a time, advanced by hitting space, with a 9). A Control X provides reverse scrolling ... also at variable speeds.

The Disk Subsystem

Aside from having the expected disk commands for saving, loading and deleting Pencil files, the disk subsystem also has SOL-20 and SOLOS/CUTER cassette input and output routines. It has commands for clearing the text buffer and clearing all the text before or after the cursor. Without a doubt, the disk capability is one of the most desirable features of the system. If you get interrupted, you can stop where you are, save the file in a matter of seconds, and come back later and pick up where you left off.

The Print Subsystem

When it comes time to dump the text onto the printer the Print Subsystem is called up ... and the fun really begins because of the many options available! You can specify the line length from 25 characters to 125, indentation can be set for 10 spaces up to 100 (why anyone would want a paragraph indented 100 spaces, I don't know!), the left margin can be adjusted, page length, spacing between pages and more.

The handy reference card provided to help acquaint you with Electric Pencil's commands.

One of my favorite features is the ability to specify spacing between lines. Manuscripts, such as this one, always need to be double-spaced. I don't have to worry about that while I'm generating the text ... I simply specify double when it's printed. Right justification or "ragged right" (which I prefer) is another option. The Diablo version also allows you to specify incremental spacing between characters.

Special Features

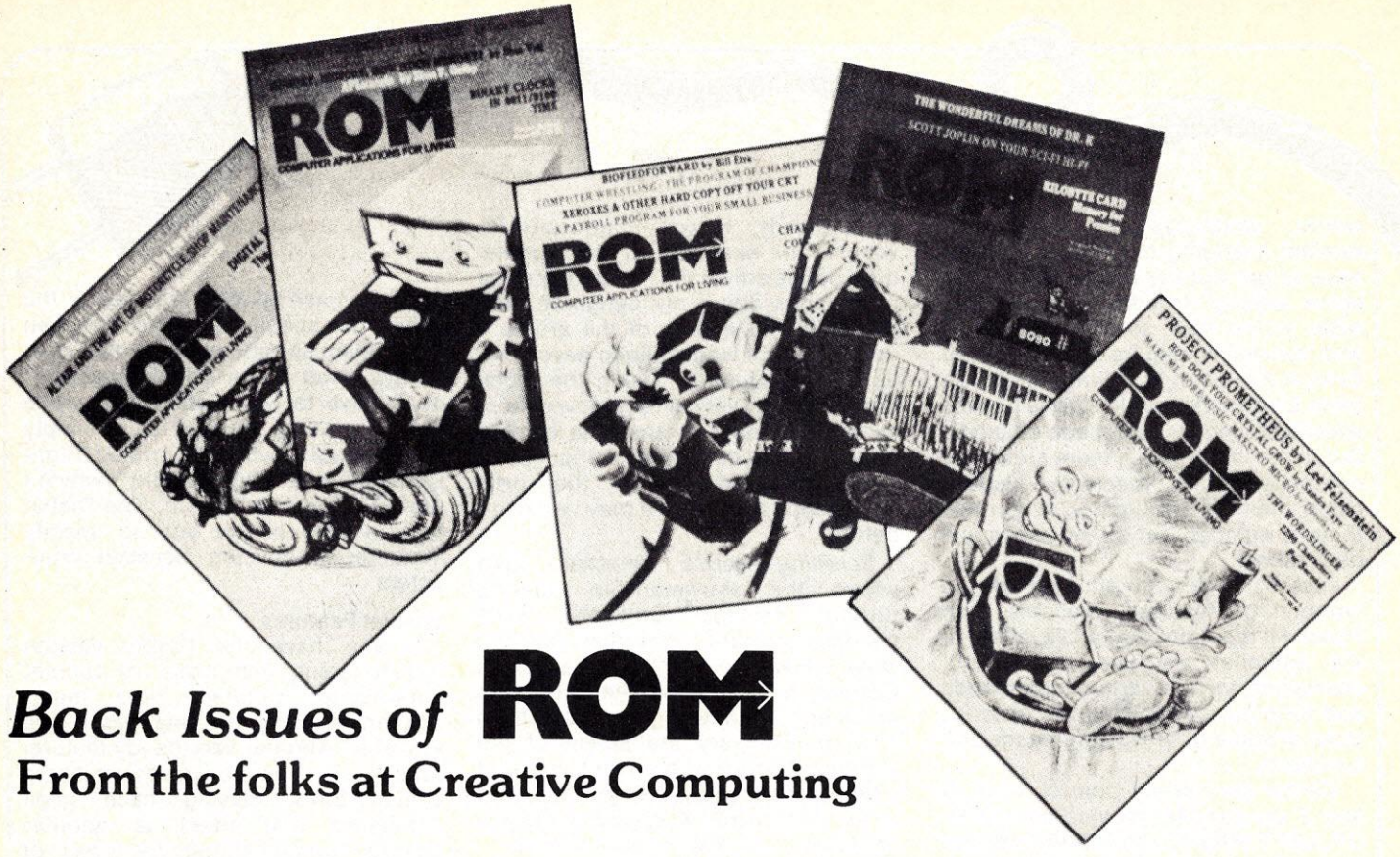
If you have the Diablo version (you're going first class, of course) underlining, boldface and multi-column printing (in one pass!) are available. Another very handy feature, available in all versions, is the ability to center titles. Having each page numbered and titled is another feature. You can change the format of the printing in "midstream," so to speak. For example, if you wanted everything up to a certain point to be doubled spaced, and everything afterwards single spaced, it will stop (if you tell it to) and allow you to enter the new format. It's also possible to put non-printing comments in the text (a handy feature which I use for putting the print specs at the beginning of certain files).

And ... I still haven't mentioned all the features!

Now For The Bad ...

One of the major complaints about Electric Pencil is that source listings aren't provided. I'll admit that I've found that to be a major irritant because there have been several occasions when I've wanted to interface to the program. However, that is not my chief complaint. I feel the features provided in Pencil more than make up for the lack of source code. Besides, I can appreciate Michael Shrayer wanting to make it difficult for anyone to steal his creation (although that isn't the reason *most* people want listings!).

No, my biggest complaint is actually related to one of the features of the system. With Electric Pencil you do not have to enter carriage returns or worry about word hyphenation. Pencil takes care of returns and line feeds. At first it takes a little getting used to (especially if you've been typing for several years). When you get to the far right, and the word you're typing will not fit on the line, Pencil will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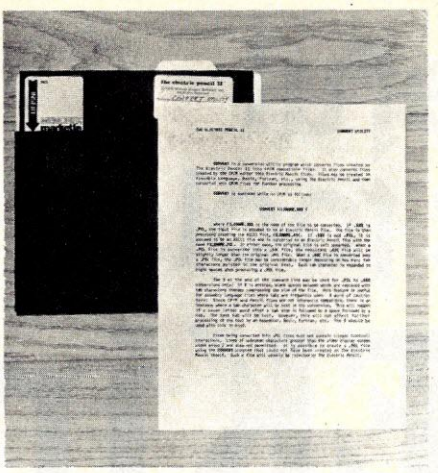
automatically detect this and move the word down to the next line. Pretty neat, huh? Well, yes and no. It goes through a lot of software manipulations when this occurs ... and things slow down! The result is, if you're any kind of a speed typist (which I am), a character is going to be lost during this "readjustment" period. I've had to train myself to slow down to one fifth speed when approaching the end of each line. I no like ... and I hope it's something that will be taken care of in future releases. (UPDATE: I just got off the phone with Michael Shrayer and he informs me that the problem I just mentioned is more hardware related than software. It can be cleared up by having the keyboard operate under interrupts. This, along with a lot of other new features, will be discussed and implemented in the next version of Pencil. He also mentioned that only a handful of people have brought this point up. Apparently there aren't that many of us computerists who are also fairly fast typists!)

Convert—A New Product

Occasionally I get into assembly-language programming and if there's a reason why I don't do more it could be because of the CP/M editor. I don't care for it at all ... and I'm not alone.

Apparently Michael Shayer dislikes it too because he came up with a program which allows you to use Pencil in place of the CP/M editor. The program is Convert and its purpose in life is to convert any ASCII files into Pencil files ... and then, after the editing, convert them back to ASCII files. It works, and it is a pure pleasure to use.



Michael Shrayer's newest development; Convert, a CP/M ASCII file character editor. Note the extensive documentation ... one page (ain't nuthin' to it ... simple to use).

The CP/M editor is line-oriented, which means you have to keep track of where you are with respect to which line of code you're operating on. It's very easy to get lost and have to type out several lines of text to find where you are again. With Pencil, and Convert, you're using a character-oriented editor and, as with just Pencil alone, you simply have to move the cursor to the point you want to change, delete, examine, or whatever.

The only drawback I can see is that you don't get a backup file when you do your editing this way (the CP/M editor creates a backup file so you have a copy of the new and the old when you're finished). Using the CP/M editor to open a file, and then exiting immediately, would take care of the problem because a backup would be generated in the process. Convert is available on CP/M diskette for $35.

Closing Thoughts

Electric Pencil is available in such a wide variety of configurations that I wouldn't begin to try and list them all here. (Take a look at one of their ads to see if it's available for your machine ... I'll bet it is!) Electric Pencil I (which has everything except the Diablo features) can be purchased on Tarbell or CUTS tape or North Star diskette from $100 to $175, depending on the configuration. Electric Pencil II, the CP/M version, is available on standard-sized diskettes or minis (for North Star or Micropolis). Versions are also available for Imsai's IMDOS, Processor Tech's HELIOS and Radio Shack's TRS-80 (cassette). Michael mentioned that some of his most enthusiastic customers in a long time are TRS-80 owners. Many of them would like to see it on disk ... which is coming soon. The main hardware requirement for running Pencil is that you have a memory-mapped video, such as Processor Tech's VDM-1, Solid State Music VB-1B, Polymorphics VT-1, Imsai VIO, or something similar. It does not work with a terminal ... and can't be modified to work with one.

In conclusion, I only have one brief, but significant, comment to make: I sure am glad I had Pencil to write this with! ■

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An interesting and useful feature of any memory mapped video display is the ability to place ASCII characters at any screen location instantly. By adding the use of control characters and reverse video, a semi-graphics capability is possible.

The programs contained in this article are examples of various possibilities and should work with any computer that has memory mapped video and the BASIC POKE and PEEK statements. Some assembly-language examples will also be given. If you have the PET you already have very nice graphics characters built-in. The SOL programs were written using Processor Technology's new Extended Basic.

Memory mapped video is a display system in which each character position on the screen is actually a memory location. The memory assigned to video is constantly scanned to refresh and update the screen. The SOL screen is located in memory from 52224 (CC00 HEX) to 53247 (CFFF HEX). This is 1024 bytes of memory, one byte for each of the 1024 screen locations (16 lines times 64 characters equals 1024). The PET screen is located from 32767 to 33766 (20 lines times 40 characters equals 1000).

The BASIC POKE statement allows you to place a byte of data into any available memory location. By POKEing video memory you can write directly to the screen. For example: POKE 52224,65 will place an "A" in the upper lefthand corner of the screen and POKE 53247,90 will cause a "Z" to appear in the lower righthand corner.

The BASIC PEEK statement is used to look at a memory location and, if desired, use the contents of that location in further data handling. X= PEEK(12345):PRINT X would print whatever was contained in the memory location 12345.

TABLE 1 is an ASCII code conversion listing. Hex, octal and decimal codes are given but BASIC always uses the decimal. Hex and octal are used in assembly language programming. In the above POKE examples, 65 is the ASCII decimal code for an "A" and 90 is the code for a "Z." The SOL uses decimal codes 128 to 255 to provide reverse (black on white) video. To figure the reverse code; add 128 to the Decimal code, 80 to the Hex code and 160 to the Octal code. Reverse "A" would be decimal 193. (65 + 128 = 193).

The Processor Technology VDM-1 video display board is the same as the SOL on-board video system. I understand that the POLY video board is similar to the VDM-1 but I'm not sure how similar. The PET uses the same ASCII codes. The PET will not display the control codes (1 to 31 and 128 to 158), however, it will display many unique graphic characters.

Table 1
An ASCII code conversion table showing the decimal, octal and hexadecimal code equivalents for each of the 128 ASCII characters. The first 32 characters are the control codes and each has a very distinctive display.

ASCII CHARACTER	DECIMAL CODE	HEXADECIMAL CODE	OCTAL CODE
NUL	00	00	00
SOH	01	01	01
STX	02	02	02
ETX	03	03	03
EOT	04	04	04
ENQ	05	05	05
ACK	06	06	06
BEL	07	07	07
BS	08	08	10
HT	09	09	11
LF	10	0A	12
VT	11	0B	13
FF	12	0C	14
CR	13	0D	15
SO	14	0E	16
SI	15	0F	17
DLE	16	10	20
DC1	17	11	21
DC2	18	12	22
DC3	19	13	23
DC4	20	14	24
NAK	21	15	25
SYN	22	16	26
ETB	23	17	27
CAN	24	18	30
EM	25	19	31
SUB	26	1A	32
ESC	27	1B	33
FS	28	1C	34
GS	29	1D	35
RS	30	1E	36
US	31	1F	37
SP	32	20	40
!	33	21	41
"	34	22	42
#	35	23	43
$	36	24	44
%	37	25	45
&	38	26	46
'	39	27	47
(	40	28	50
)	41	29	51
*	42	2A	52
+	43	2B	53
,	44	2C	54
-	45	2D	55
.	46	2E	56
/	47	2F	57
0	48	30	60
1	49	31	61
2	50	32	62
3	51	33	63
4	52	34	64
5	53	35	65
6	54	36	66
7	55	37	67
8	56	38	70
9	57	39	71
:	58	3A	72
;	59	3B	73
<	60	3C	74
=	61	3D	75
>	62	3E	76
?	63	3F	77
@	64	40	80
A	65	41	81
B	66	42	82
C	67	43	83
D	68	44	84
E	69	45	85
F	70	46	86
G	71	47	87
H	72	48	90
I	73	49	91
J	74	4A	92
K	75	4B	93
L	76	4C	94
M	77	4D	95
N	78	4E	96
O	79	4F	97
P	80	50	100
Q	81	51	101
R	82	52	102
S	83	53	103
T	84	54	104
U	85	55	105
V	86	56	106
W	87	57	107
X	88	58	110
Y	89	59	111
Z	90	5A	112
[	91	5B	113
\	92	5C	114
]	93	5D	115
↑	94	5E	116
←	95	5F	117
a	97	61	121
b	98	62	122
c	99	63	123
d	100	64	124
e	101	65	125
f	102	66	126
g	103	67	127
h	104	68	130
i	105	69	131
j	106	6A	132
k	107	6B	133
l	108	6C	134
m	109	6D	135
n	110	6E	136
o	111	6F	137
p	112	70	140
q	113	71	141
r	114	72	142
s	115	73	143
t	116	74	144
u	117	75	145
v	118	76	146
w	119	77	147
x	120	78	150
y	121	79	151
z	122	7A	152
{	123	7B	153
|	124	7C	154
}	125	7D	155
~	126	7E	156
DEL	127	7F	157

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BASIC Programs

PROGRAM A will fill the SOL screen with the contents of the character generator. This will give you an idea of what everything looks like. PROGRAM B will do the same for the PET. LINE 20 clears the screen and homes the cursor, 30 sets the beginning of the screen and 40 to 60 POKEs the screen with consecutive characters out of the character generator.

PROGRAM A
This program will fill the screen with the contents of the character generator ROM. LINE 20 clears the screen and homes the cursor. In order for the SOL to display control characters, switch S1-3 on the main CPU board must be turned off.

```
10 REM- POKE DISPLAY - SOL
20 PRINT CHR(11)
30 LET S=52223
40 FOR I=1 TO 1024
50   POKE S+I,I
60 NEXT I
70 END
```

PROGRAM B
This BASIC program does the same for the PET that PROGRAM A does for the SOL. If you add a new LINE, 25 POKE 59469, 14 lowercase letters will be displayed instead of graphics characters. They can not both be used at the same time.

```
10   REM - POKE DISPLAY
20   PRINT CHR$(147)
30   LET S=32767
40   FOR I = 1 TO 1000
50      POKE S+I,I
60   NEXT I
70   END
```

PROGRAM C will let you place any desired characters into consecutive screen locations, starting with screen line 3 (so as not to disturb lines 1 and 2 where we will be inputing). Again, LINE 20 clears and homes, 30 sets the screen address, and 40 to 90 loop to address consecutive locations. LINE 50 keeps the input statement in the home position so that it doesn't overwrite our doodling. 60 asks for a character (0 to 255), 70 let's you out of the loop if you input a 0 and 80 prints the character.

PROGRAM D allows you to select the screen coordinates where you wish each character placed. LINE 50 asks for the horizontal position (1 to 64), the vertical position (1 to 16) and the desired character (0 to 255). LINE 60 calculates the selected position, 70 keeps the cursor home, 80 exits if 0 is entered for X and 90 prints the desired character to the screen.

PROGRAM C
Any ASCII code, 1 to 255, can be entered in response to the Input in LINE 60 and it will be immediately placed on the screen. Entering a zero will terminate the loop.

```
10 REM- KEYBOARD POKE - SOL
20 PRINT CHR(11)
30 LET S=52223
40 FOR I=129 TO 1024
50   PRINT CHR(14)
60   INPUT A
70   IF A=0 THEN  END
80   POKE S+I,A
90 NEXT I
100 END
```

PROGRAM D
This will ask for a horizontal location (1 to 64), a vertical location (1 to 16) and a character (1 to 255). LINE 60 will compute the desired location, 70 will keep the cursor at home out of the way and 90 will display the asked for character in the location called for.

```
10 REM- X-Y POKE - SOL
20 PRINT CHR(11)
30 LET S=52223
40 FOR I=1 TO 1024
50   INPUT "HORIZ, VERT,
            CHAR ? ",X,Y,Z
60   LET A=S+X+((Y-1)*64)
70   PRINT CHR(14)
80   IF X=0 THEN  END
90   POKE A,Z
100 NEXT I
110 END
```

Assembly Language Programs

Any of the above programs could have been written in 8080 assembly language. PROGRAM E shows how PROGRAM A would look in assembly language for the SOL. The resulting screen display would be the same for A or E.

PROGRAM F is called "Flash" because it can flash two or more pictures onto the screen in sequence. If we were to store a picture in a one kilobyte block of memory other than that used for video memory, we could cause it to appear on the screen at any time by using a block move routine. If we had two or more pictures stored in different locations we could call up any or all of them in any sequence.

The 8080 machine code from 0000 to 000F in PROGRAM F will move a 1K block of memory, whose starting address is entered into 0004 and 0005, directly to the screen. 000C should reflect the high order address immediately following the end of the 1K. For instance, if the 1K block is located from 0400 to 07FF, 000C would be 08. This will terminate the block move routine.

0010 is a call to a delay routine and 0013 to 0028 will move a second 1K block to the screen. This block is located in memory from 0800 to 0BFF. 001F is 0C which is the high order address directly above 0BFF. This is used to end this block move.

Up to this point, PROGRAM F will move a picture (located at 0400 to 07FF) to the screen, delay for a while, and then move another picture (located at 0800 to 0BFF) to the screen. The length of the delay is determined by the machine code in 002A and 002B. FF FF would give us a long delay and 01 00 a very short one. If too short a delay is used, the two pictures will both appear to be on the screen at the same time. Since there is no exit in this program, it will continue to alternate pictures until the reset or mode key is pressed.

However, first you have to place your pictures into these locations. The pictures can be anything you desire. 0033 to 0052 load alternate stripes into 0400 to 07FF. These really don't serve any purpose except to show what it is possible to do. After you have all of PROGRAM F loaded into memory, EXECUTE 0033. Then change 0035 to 08, 0039 to 20, 0043 to A0 and 004C to 0C. Now EXECUTE 0033 again. This will load stripes into 0800 to 0BFF also, but they will be out of phase with those in 0400 to 07FF.

Everything is now ready to go and you can EXECUTE 0000. This should cause black and white stripes to flash on the screen in an alternating fashion. By placing different ASCII characters (00 to FF) into locations 0039 and 0043 and EXECUTEing 0033, many unusual displays can be generated. You can also eliminate 0033 to 0052 and load your picture storage with anything you like.

These pictures could be two game boards, one for each of two players and each would be brought to the screen as the players took turns. They can also be charts or graphs which are brought to the screen updated and stored away again. These are only a few of the many uses that are possible.

Random POKEing

As far as hardware or software results are concerned, PROGRAMS G, H and I do absolutely nothing. They are all random POKEers. Watching the patterns that they generate on the screen is like studying cloud formations or viewing the stars. What you see depends on what you are and how you think. Since no two people will see the same things, what you perceive as a horse I might see as a tree.

These three programs use a random number generator to POKE random

```
ADDRESS   CODE      MNEMONIC      COMMENT
0000      21 00 CC    LXI H       INITIALIZE SCREEN ADDRESS
0003      1E 04       MVI E       DO ROUTINE 4 TIMES
0005      AF          XRA A       ZERO ACCUMULATOR
0006      77          MOV M A     ASCII TO SCREEN ADDRESS
0007      23          INX H       BUMP ADDRESS COUNTER
0008      3C          INR A       BUMP ASCII CHARACTER CODE
0009      FE FF       CPI         ALL 256 CHARACTERS DONE?
000B      C2 06 00    JNZ         IF NOT - GO BACK
000E      1D          DCR E       DECREMENT LOOP COUNTER
000F      C2 05 00    JNZ         AND CHECK FOR DONE
0011      C3 04 C0    JMP         GO TO MONITOR PROGRAM
```

PROGRAM E

This is an assembly language version of PROGRAM A written for the 8080 CPU. It will fill the screen four times with the contents of the character generator ROM.

```
0000      21 00 CC    LXI H       INITIALIZE SCREEN ADDRESS
0003      11 00 04    LXI D       POINT SCREEN 1 STORAGE
0006      1A          LDAX D      LOAD A FROM STORAGE
0007      77          MOV M A     MOVE TO SCREEN
0008      23          INX H       BUMP SCREEN COUNTER
0009      13          INX D       BUMP STORAGE COUNTER
000A      7A          MOV A D     LOAD D AND CHECK
000B      FE 08       CPI         FOR DONE - IF NOT
000D      C2 06 00    JNZ         GO BACK AGAIN
0010      CD 29 00    CALL        DELAY ROUTINE
0013      21 00 CC    LXI H       INITIALIZE SCREEN ADDRESS
0016      11 00 08    LXI D       POINT SCREEN 2 STORAGE
0019      1A          LDAX D      LOAD A FROM STORAGE
001A      77          MOV M A     MOVE TO SCREEN
001B      23          INX H       BUMP SCREEN COUNTER
001C      13          INX D       BUMP STORAGE COUNTER
001D      7A          MOV A D     LOAD D AND CHECK
001E      FE 0C       CPI         FOR DONE - IF NOT
0020      C2 19 00    JNZ         GO BACK AGAIN
0023      CD 29 00    CALL        DELAY
0026      C3 00 00    JUMP        DO IT ALL OVER AGAIN
0029      01 00 40    LXI B       SET DELAY
002C      0B          DCX B       DECREMENT DELAY
002D      AF          XRA A       CLEAR ACCUMULATOR
002E      B8          CMP B       DELAY DONE?
002F      C2 2C 00    JNZ         IF NOT - LOOP
0032      C9          RET         RETURN
0033      21 00 04    LXI H       SET STORAGE POINTER
0036      16 40       MVI D       SET CHARACTER COUNTER
0038      3E A0       MVI A       LOAD DISPLAY CHARACTER
003A      77          MOV M A     MOVE TO STORAGE
003B      23          INX H       BUMP STORAGE POINTER
003C      15          DCR D       CHECK FOR DONE
003D      C2 3A 00    JNZ         IF NOT - GO BACK
0040      16 40       MVI D       LOAD CHARACTER COUNTER
0042      3E 20       MVI A       LOAD DISPLAY CHARACTER
0044      77          MOV M A     MOVE TO STORAGE
0045      23          INX H       BUMP STORAGE COUNTER
0046      15          DCR D       CHECK FOR DONE
0047      C2 44 00    JNZ         IF NOT - GO BACK
004A      7C          MOV A H     LOAD H AND CHECK
004B      FE 08       CPI         FOR DONE - IF NOT
004D      C2 36 00    JNZ         GO BACK AGAIN
0050      C3 04 C0    JMP         GOTO SOL MONITOR
```

PROGRAM F

FLASH will alternately place the two pictures stored at 0400 to 07FF and 0800 to 0BFF onto the screen. 0033 to 0052 can be used to store black and white stripes for demonstration purposes as explained in the text.

screen locations. First the screen is filled with "*"s, then spaces suck out the "*"s, and then the spaces are in turn blotted out with reverse "*"s.

LINE 80 in G and H generates a random number between 1 and 1024. LINEs 90 and 100 check to see what that location contains and then POKE accordingly. The loop in LINE 70 can be made larger or smaller to suit your desires.

PROGRAM I, an extended version of G, continues the sequence of POKEd characters to twenty additional selections. The Z array in LINE 70 keeps track of what has happened to each location so that LINEs 110 and 120 know what to POKE. LINE 150 changes the characters used for each J loop. Finally, in LINEs 170 to 200, an attempt is made to cursor out the whole screen. How successful this attempt is, depends on the number of loops written into LINE 170 and on how random your random number generator really is.

Conclusion

I've been fascinated by computer graphics since I first got my SOL. I understand that Processor Technology will be coming out with a graphics add-on soon. There are also a couple of other companies that are producing SOL graphics boards but I haven't seen them yet. I'd like to thank Bob Webb of Sierra Vista, AZ for the use of his PET to verify the PET routines included in this article.

This is just the beginning. I'm sure that each of you who try out these routines will find other interesting possibilities. If you do, don't keep them to yourselves. ■

PROGRAM G
The random POKEr. Variable A = *, B = space, and C = reverse *. LINEs 90 and 100 check to see what the randomly selected location contains and then POKEs the next desired character.

```
10 REM- RANDOM POKE - SOL
20 PRINT CHR(11)
30 LET A=42: LET B=32: LET C=170: LET S=52223
40 FOR I=1 TO 1024
50   POKE S+I,A
60 NEXT I
70 FOR J=1 TO 1000
80   LET P=INT(RND(0)*1023+1)
90   IF PEEK(S+P)=B THEN  POKE S+P,C
100  IF PEEK(S+P)=A THEN  POKE S+P,B
110 NEXT J
120 END
```

PROGRAM H
PROGRAM G rewritten for the PET. LINE 20 clears the screen and homes the cursor. The variable S is equal to the first screen location in memory.

```
10 REM- RANDOM POKE - PET
20 PRINT CHR$(147)
30 LET A=42: LET B=32: LET C=170: LET S=32767
40 FOR I=1 TO 1000
50   POKE S+I,A
60 NEXT I
70 FOR J=1 TO 1000
80   LET P=INT(RND(0)*999+1)
90   IF PEEK(S+P)=B THEN  POKE S+P,C
100  IF PEEK(S+P)=A THEN  POKE S+P,B
110 NEXT J
120 END
```

PROGRAM I
This extended BASIC POKE routine runs on and on and on. It might even put you to sleep. It hypnotizes me. After running the same sequence of characters as PROGRAM F, it changes the characters in LINE 150 and then runs the loop again. This takes place ten times. The Z array keeps track of what has happened to each location and LINES 110 and 120 POKE accordingly. LINEs 170 to 200 attempt to cursor out the entire screen as a finale.

```
10 REM- EXTENDED RANDOM POKE - SOL
20 PRINT CHR(11)
30 LET A=42: LET B=32: LET C=170: LET S=52223
40 FOR I=1 TO 1024
50   POKE S+I,A
60 NEXT I
70 DIM Z(1024)
80 FOR J=0 TO 9
90   FOR K=1 TO 1024
100    LET P=INT(RND(0)*1023+1)
110    IF Z(P)<=J THEN  POKE S+P,B
120    IF Z(P)=J+1 THEN  POKE S+P,C
130    LET Z(P)=J+1
140  NEXT K
150  LET B=J+5: LET C=J+133
160 NEXT J
170 FOR I=1 TO 2500
180   LET P=INT(RND(0)*1024)
190   POKE S+P,160
200 NEXT I
210 END
```

Note: The preceding SOL programs, which were written in Processor Technology's new Extended Basic, are not entirely compatible with MicroSoft Basic. For example, in Program A, the CHR(11) in statement 20 needs to be changed to CHR$(11) in order to send a clear screen command to the video display. The POKE statement in line number 50 will have to be modified also. The second argument ("1") has a range of 255 for a MicroSoft POKE (i.e., the maximum number of ASCII characters; reversed video and normal). The PT Extended Basic goes up to 1024 (and probably beyond). —John.

PET WORD PROCESSOR

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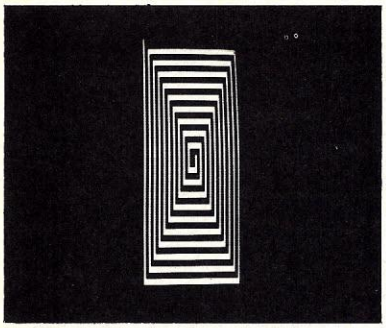

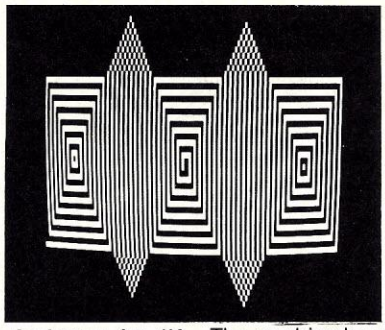

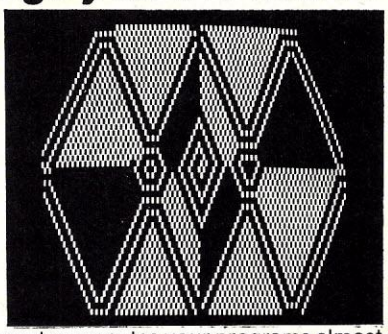

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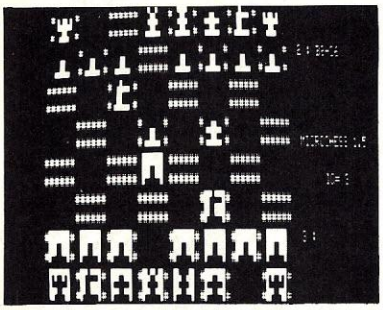

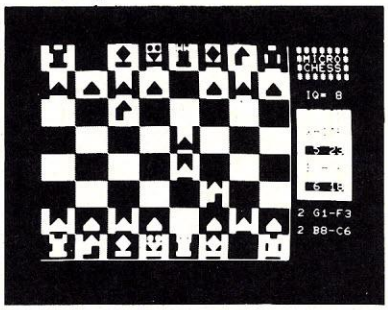

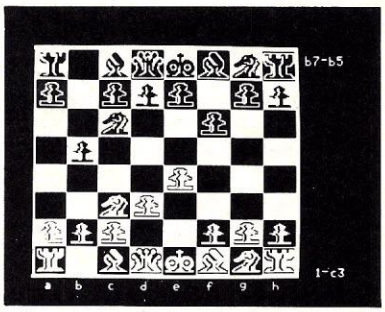

MICROCHESS is the culmination of two years of chessplaying program development by **Peter Jennings**, author of the famous 1K byte chess program for the KIM-1. MICROCHESS 2.0 for 8K PETs and 16K APPLEs, in 6502 machine language, offers 8 levels of play to suit everyone from the beginner learning chess to the serious player. It examines positions as many as 6 moves ahead, and includes a chess clock for tournament play. MICROCHESS 1.5 for 4K TRS-80s, in Z-80 machine language, offers 3 levels of play (both Level I and Level II versions are included and can be loaded on any TRS-80 without TBUG). MICROCHESS checks every move for legality and displays the current position on a graphic chessboard. You can play White or Black, set up and play from special board positions, or even watch the computer play against itself! Available now at a special introductory price of only **$19.95**

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EXPANSION

"This circumstance of an expanding Universe is irritating." *Albert Einstein*

The morning it took me ten minutes to stumble from the bedroom to the bathroom, I realized that something was amiss. When it took me nearly half an hour to reach the kitchen and my morning cup of coffee, that confirmed it.

So I sat down and calmly evaluated the situation.

My first idea was that I was still dreaming, or worse, somehow caught in a holographic Salvador Dali painting.

I then remembered that just before falling asleep I read that the Universe was expanding. Nearly all the observable galaxies are moving away from Earth at high speeds. The further away they are the faster they are moving, until the most distant galaxy is moving at a rate of over a *billion miles per hour*.

At that late hour, all I could think was, "Where the hell's the fire?"

Well, I saw that it was indeed a fact, and what's more it was expanding right in my own home!

Let me explain.

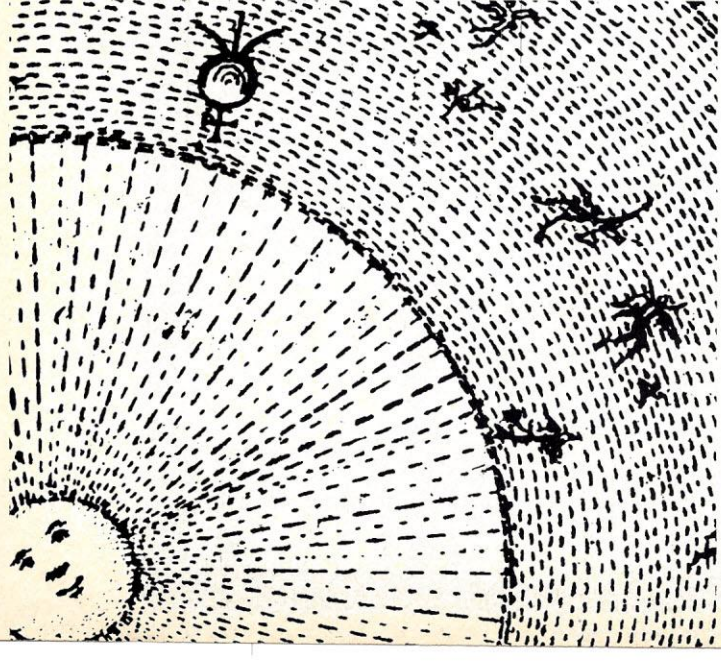
When I attempted to walk to my study, to put in an honest days work at the typewriter, I had to outfit myself with hiking pants, boots and bring along enough supplies to brave two cold nights in the desolate hallway.

By the time I finally reached my destination, tired and dirty, the original inspiration had withered away like a delicate flower without water.

Deeply saddened and distressed I thought I'd tread back to the bedroom and get a good nights sleep. Luckily I remembered to bring binoculars, so that I could see my objective, now just barely visible on the horizon.

It was at that point that I finally concluded that the human was indeed a cursed race: First daytime television, then the neutron bomb, and now an expanding universe.

Where is Isaac Newton when you need him? ■



THE REALITY BROKER

The reality broker opened a little black bag, which he promised contained many diverse levels of reality. One region, in the deepest part of the bag, contained assorted philosophical principles: Platonic *nouses*, Hegelian *absolutes*, and Heisenbergian *uncertainties*, among them. Each kit came with an illustrated instruction booklet on how to construct these complicated contemplations out of ordinary everyday thoughts. I couldn't get into anything on that profound level, so I asked for a peek into the next section. Now, this realm of reality was something I could better grasp, always fancying myself as a practical man. There were all sorts of material objects from around the world, which were guaranteed by a certified rationalist to possess actuality, factuality & reality. These items, which made-up most of the bulk of the bag, consisted of rocks, ash trays, pencils, chewing gum, toilet tissue, plus genuine replica's of (among other things) the Empire State Building. Also, at a reduced rate, he had what he called "pot luck", a plastic baggie containing assorted *ipso factos*. When he was through showing me his stock, I asked rather coyly, (not letting our eyes meet and in a low hushed tone), "Ahem, don't you have any of the "hot stuff"?" He looked shocked that I should suggest such a thing of him, and at once produced his badge which signified that he had a licence and was indeed legitimate. However, when I relentlessly persisted, he broke down and anxiously admitted that he did carry enough *smut* to satisfy the desires of any grown man. Just as I suspected, his bag had a false lining and was loaded with a wide variety of *unrealities*. I loaded-up with so many pipedreams, whimseys, illusions and other perversities, that he threw-in a handful of lesser absurdities, gratis! ■

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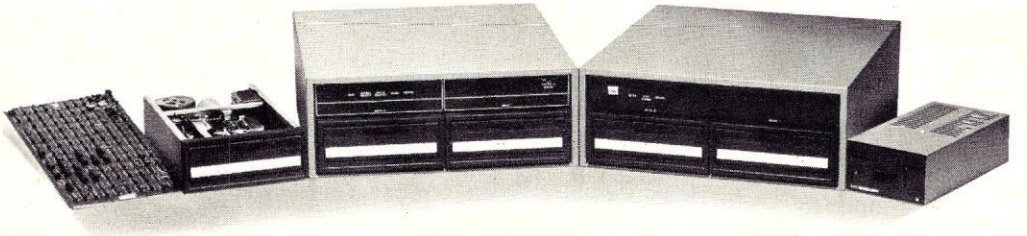

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Music Composition: A New Technique

Steven K. Roberts

Another article on music generation? This one presents some new, simplified techniques for composing your own.

Mathematics is music for the mind; Music is mathematics for the soul.

—ANONYMOUS

The delightful ease with which a microprocessor may be interfaced with sound-generating hardware seems to tempt nearly every personal computer owner with the idea of producing music. Ever since the early days of the 8008 and the infamous AM radio interface, techniques and software tricks for playing tunes with the various micros have peppered the pages of our chosen magazines. There are now a variety of products on the market that in some way contribute to the implementation of a computer music system.

Throughout all the fuss, I have seen surprisingly little on the subject of composition with the computer, perhaps because any tunes of more than trivial significance seem to require rather elaborate software. There are idiomatic structures to worry about, keys and accidentals, rhythmic patterns ... not to mention the aesthetic problems of avoiding banality and obvious repetition. Perhaps the compositional techniques that lie beyond the realm of the self-evident (random numbers) have remained in the computer music laboratories and scholarly journals. Whatever the case, a minor breakthrough of sorts has just manifested itself in the work of Richard E. Voss and Benoit Mandelbrot, recently reported in the April, 1978 issue of Scientific American. A simple technique now exists which allows the computer generation of pleasing sequences of tones with some surprising properties.

Without delving too deeply into the mathematics involved, the work of Voss and Mandelbrot can be best understood by starting with a simple sequence of random numbers. In order to develop the application to computer music, let's look at a BASIC program to generate them (Program A). This program repeatedly generates a random (actually pseudorandom) number in the range 0-59, or five octaves, and outputs it after some conversion to port 17 of the system. Lines 30, 40 and 50 are installation-dependent, serving in the system for which this was written to convert the raw binary number (A) into a format the custom-designed note selection logic can understand. (It requires a byte whose low four bits are a note code and whose next three bits define an octave.) Lines 70 and 80 simply delay the loop long enough for the individual notes to be discernible.

Needless to say, the output from the program in Program A is boring. It has no internal structure governing the passage of one note to the next (its autocorrelation function is zero) and it totally fails to satisfy whatever intellectual and emotional criteria we apply when we attempt to decide whether or not something is "music." One of the most important of these criteria is the balance between the anticipated and the unanticipated, a key interrelationship that caused Beethoven to observe: "Everything in music must be at once surprising and expected." Within this context, we can easily generate the two extremes—the totally surprising with Program A and the totally expected with the concept in Program B.

The BASIC program in Program B is the next step in sequence abstraction; being a method of generating random intervals from a previous state rather than random notes. Each pass through the loop displaces the current note value by some amount less than eight half-steps in either direction. The relatively wide intervalic range of eight is an attempt to introduce some surprise into the melody, and results in an effect somewhat more pleasing than before but still with little, if any, aesthetic appeal. The sequence wanders up and down the scale and is randomly relocated upon encountering either extreme. The major conceptual difference of this from the first form is that its value at any point is very much a function of its recent past (depending on the intervalic range) and it is thus highly autocorrelated.

These forms of computer tune generation have served as the jumping-off point for a number of serious attempts at composition in recent years, giving birth to, among other things, the concept of "stochastic" music. Basically, this approach to composition is based upon a series of

Program A: Random Tone Generator

```
10 RANDOMIZE
20 A=INT(60*RND(0))          ;Select random note value 0-59
30 T=A/12                    ;Calculate Octave
40 N=INT(A-12*T)             ;Calculate Note
50 V=16*T+N                  ;Produce composite octave/note code
60 OUT 17,V                  ;Output to hardware
70  FOR D=0 TO 100
80  NEXT D                   ;Delay
90 GOTO 20
```

Program B: Random Interval Generator

```
10 RANDOMIZE
20 B=48                      ;Starting location in scale
30 A=INT(17*RND(0)-8)        ;Random interval of ±8 maximum
60 A=A+B                     ;Displace from last position
70 IF A<16 OR A>97 THEN 160 ;If over- or under-flow, random relocation
80 B=A
90 T=INT(A/12)               ;Octave/note calculation
100 N=INT(A-12*T)
110 V=16*T+N
120 OUT 17,V                 ;Output to hardware
130  FOR D=0 TO 100
140  NEXT D                  ;Delay
150 GOTO 30
160 A=16+70*RND(0)           ;Select new random note point
170 GOTO 80
```

Steven K. Roberts, 10513 Fairview Avenue, Jeffersontown, Kentucky 40299

statistically-derived transition and rejection rules, which govern the probability of a passage from one note or sequence to the next. Within this broad category, examples of a musical idiom (such as Chopin Waltzes) have been analyzed, and their characteristics summarized in a collection of rules which are then used to constrain a sequence of random numbers. The result is something which, over a limited time span, is suggestive of the style of the original, but still suffers from banality when experienced to any significant extent. Stochastic music is a brave but generally unsuccessful attempt at mediation (statistically speaking) between the two extremes described so far.

It is here that the recent work of Voss and Mandelbrot enters the picture. Voss introduced the concept of "one-over-*f*" noise, wherein the values comprising a sequence are functions not only of their recent past, but of their *entire* past. Mandelbrot named the fluctuations *fractals* and made a number of startling discoveries about their appearance in nature: not only do such relationships characterize variations in annual flood levels of the Nile, the geometry of seacoasts and mountain ranges, and the clustering of stars, but it also appears that our nervous systems reduce the massive parallel input from the outside world to information that behaves statistically like 1/f noise.

Applied to music composition, fractal patterns produce results that are astonishingly familiar. If such relationships characterize much abstract art, nature's whimsy, and even the behavior of our nervous systems, then, embodied in musical form, may they not offer greater potential reward than the white noise of random numbers or the rigid rules of stochastic composition?

Voss thought so. He has investigated fractal music with promising results, and has suggested a conceptual technique for its computer implementation. With that as a basis, I developed the BASIC program shown in Program C. It may be considered a starting point for deep exploration of the possibilities inherent in these sequences.

The intent of this program is the continuous generation of an algorithmically structured sequence of tones with a random basis and a 1/f frequency distribution. This apparent self-contradiction is resolved by the following logic:

Assume that any note's value is the sum (S) of eight intermediate values in the range 0-7, resident in Array A. This allows a musical range of 56 possible notes. Begin the sequence with the eight elements of Array A randomly assigned, and with a counter (X) set to zero. To determine the next note in the sequence, increment X and note which bits changed (either way). The elements of the Array, indexed by the bit numbers that changed during the increment, are then given new random values in the range 0-7. These are then summed, as before, to yield the new note. It may be seen that the pattern of changing bits as X passes through its 256 count range will cause structuring of the sequence in a fashion that allows the higher-order values to be progressively more stable, preventing wild excursions of the melody. A moment's thought on the curve generated by the "changing bits" concept will give some insight into the loose schematic structure of the resulting tune.

In Program C this algorithm has been implemented. The changing bits are determined by performing an Exclusive-OR between the old value of X and the new, then successively subtracting the binarily weighted values in Array B from the result, reassigning the corresponding elements of A until underflow occurs on a subtraction. The note value (S), as explained above, is then derived by summing those elements, whereupon it is subjected to a validity test (to maintain the integrity of the chosen key signature), converted to octave/note format, and output to the hardware. The DATA statement in line 420 selects the number of notes within one octave of the key, and the DATA statement following specifies the notes in the key (numbered 0-11). The one shown is D major. If line 420 is 11 and line 430 is 0,1,2, ... ,10,11 the result will be chromatic "riffs" unconstrained by any limitation.

Where to from here? Depending upon the stylistic parameters of your chosen musical forms, any of a number of enhancements can be added. For example, a rhythmic structure can be established, either rigid or based upon another 1/f sequence, and transition rules applied in the manner of stochastic music. A "theme and variations" form could be easily established, with the program generating ever more elaborate embellishments upon its initial fractal theme. And, with ever easier methods of realtime sound generation and the titillating prospect of home multiprocessing, can orchestration be more than a few half-steps away? ■

1. *Scientific American, April, 1978. "Mathematical Games" by Martin Gardner*
2. *Music by Computers, edited by Heinz von Foerster and James W. Beauchamp. Wiley and Sons.*

Program C: Fractal Sequence Generator

```
10 RANDOMIZE
20 RESTORE
30 REM  1/F SEQUENCE GENERATOR FOR FRACTAL COMPOSITION
40 DIM A(8),B(8),C(12)
50 X=0                          ;X is "bit change" counter
60  FOR I=0 TO 7
70  READ B(I)                   ;Array B contains Binary Weight Values
80  NEXT I
90 READ C                       ;C=number of notes in one octave of scale
100  FOR I=0 TO C
110  READ C(I)                  ;Array C contains allowable note values
120  NEXT I
130  FOR I=0 TO 7
140  A(I)=INT(8*RND(0))         ;Array A contains intermediate values -
150  NEXT I                     ; start them randomly
160 S=0                         ;S is binary note value
170  FOR I=0 TO 7
180  S=S+A(I)                   ;Sum elements of A into S
190  NEXT I
200 J=BINAND(S,%003F%)          ;Mask S to 6 bits (64 value range)
210 T=INT(J/12)                 ;Determine Octave
220 N=J-12*T                    ;Determine Note
230  FOR I=0 TO C
240  IF N=C(I)THEN 270          ;Scan allowable note array to check validity
250  NEXT I
260 GOTO 310                    ;If no good, go make another
270 V=16+16*T+N                 ;Otherwise, assemble composite note code
280 OUT 17,V+16                 ;Output (shifted one octave) to hardware
290  FOR D=0 TO 10
300  NEXT D                     ;Delay
310 Y=X : X=X+1                 ;Y saves X, increment X
320 IF X=256 THEN X=0           ;If it wraps, reset it
330 Z=BINXOR(X,Y)               ;Set any bits changed on increment
340  FOR I=0 TO 7
350  Z=Z-B(I)                   ;Scan resulting bit map by subtracting weights
360  IF Z<0 THEN 160            ;Go do a note on underflow
370  A(I)=INT(8*RND(0))         ;Any changed bit causes new random value for A(I)
380  NEXT I
390 GOTO 160
400 DATA 1,2,4,8,16,32,64,128   ;Binary Weighting Values
410 REM SCALE INFORMATION: # OF NOTES, THEN NOTES
420 DATA 6
430 DATA 1,2,4,6,7,9,11  ;D major key
440 END
```

Four Computer Music Records

David H. Ahl

Computer music is hardly new, but a new interest in it has been rekindled with the advent of synthesizer kits and home-brew setups made possible by low-cost microcomputers. Also, it's much more easier to economically justify tying up a SOL-20 for several hours than a 370/168 to produce a few minutes of music.

Much of the music transcribed for microcomputer music synthesizers comes out of the baroque period. The fugal constructions tend to sound quite satisfactory when played by somewhat limited instrumentation of the first microcomputer synthesizers (1976-77).

The second-generation synthesizers (1978-79) give the user much more control over the envelope or shape of each note. Consequently, a much wider variety of music from the Beatles to Sousa is now being transcribed for digital reproduction.

The first two records are representative of a typical commercial synthesizer (ALF) and home-brew synthesizer (Schertz). The other two are an example of a computer controlling an existing music device (organ).

Computer Controlled Synthesizer Performances, Tesseract Records, Div. of ALF Products, 128 South Taft, Denver, Co., 80228. $4.00 postpaid.

The music devices used on this record are a "Mesmerelda" six-channel synthesizer (for five pieces) and an "AD8" eight-channel synthesizer (for eight pieces). The Mesmerelda was constructed in 1974 out of TTL integrated circuits and can produce only square waves. Consequently it sounds very much like a cheap electronic organ. Nevertheless, as the jacket notes mention, "the low $400 cost made this acceptable." Certainly it is quite acceptable to play Bach on this type of "instrument," however, Joplin's "The Entertainer" suffers somewhat.

The AD8 is much more interesting because it is essentially the same device as ALF is offering for use in S-100 bus computers. This synthesizer has 256 volume levels, programmable filters, complete envelope control along with 96 different pitches. The musical effects range from rather enchanting in "Reverie" by Debussy to complex in Prokofiev's "March from 'Love of 3 Oranges'" to precise in several Bach fugues to rather bizarre (Phil Tubb would rather I said "interesting") in John Ridges piece "Ruffles" and Phil Tubb's arrangement of Bach's "Musette." Especially interesting is the comparison of "The Entertainer" played on the AD8 with the Mesmerelda version.

All in all, this record is easily worth $4.00 to play on your stereo system.

Bits and Bytes (Bach, Binary & Boolean), Schertz Computer Music, P.O. Box 8743-NPS, Monterey, Ca., 93940. 25 min. $6.00 postpaid.

On this record, a MITS Altair 8800A with 20k of memory is used to control 3 identical, but independent hardware voices. All computer equipment was built from kits and surplus. The synthesizer is an original design by Don Schertz and John Pratt which allows up to 25 parameters to control the note for each voice. Some of the parameters that can be controlled are: note pitch, wave form, attack, sustain, volume, decay, staccato, percussion, tremolo, vibrato, etc.

The fifteen selections cover a wide range from classical (Bach 3-part inventions) to old favorites (Glow Worm, Jalousie) to rag (Joplin's Sun Flower Slow Drag) to march (Entry of the Gladiators) to popular (Lara's Theme). One of the most interesting pieces is Glow Worm which has been recorded four times using various voicings and tempos. The first is a very slow rendition which allows you to clearly hear the complex details of the runs and fast passages. Mockin' Bird Hill is also recorded three times at various speeds.

The 25 minutes goes by very quickly and seems to us a bit short for a 12" LP, nevertheless the amazing effects that Don Schertz and John Pratt wring out of a home-brew synthesizer make the record a worthwhile addition to your library.

Unplayed by Human Hands, Computer Humanities Records, 2310 El Moreno, La Crescenta, Ca., 91214. Two LPs, CR9115, CH9771 $6.98 each.

Unlike the first two records, this pair uses a PDP-8 minicomputer driving a 90-rank Schlicker pipe organ. The computer is able to control all the various actions of the organ including the Great division, two Swell divisions, three other divisions, a Trompeta Real and a section of reeds. As might be expected, the organ has a rich and extensive pallet of tonal textures available and the computer adds a preciseness seldom heard with a human player.

The producer, Kenneth Knowlton is not only a computer programmer but an accomplished musician. He has chosen a wide range of compositions to show off his computer/organ combination. The jacket notes mention "that Pastoral in F by Roger-Ducasse was especially chosen because of its inordinate difficulty for even the most accomplished organist." Needless to say, the PDP-8 plays it perfectly.

I found Joplin's "Maple Leaf Rag" strange played on the organ—it just didn't seem to belong. Ditto for Mozart's "Overture from the Marriage of Figaro." Perhaps the familiarity of hearing a piece played by a piano or an orchestra is difficult to overcome. Those of you who recall the series of organ records from Cook Laboratories by Reginald Foort on the Richmond Mosque pipe organ will find memories rekindled in the piece "Entry of the Privileged Landholding Class" (CH9771). Unfortunately CH9771 was recorded before a live audience and the inevitable coughs and audience noises were somewhat annoying. Personally, I found the selection of pieces on CR9115 more satisfying (mostly classics) compared to CH9771 (more modern).

Schwann-1 now carries a regular section on Electronic Music. I would be pleased to hear from readers who have other computer and electronic music records and would like to write a short (or long) review of them. ■

Introducing the personal computer you've waited for. The Exidy Sorcerer.

I didn't buy my personal computer until I found the one that had all the features I was looking for.

The Exidy Sorcerer does everything I wanted to do and a few things I never dreamed of.

It isn't magic. Exidy started with the best features of other computers, added some tricks of their own, and put it all together with more flexibility than ever before available. Presto! My reasons for waiting just disappeared.

I wanted pre-packaged programs. Software on inexpensive cassette tapes for the Sorcerer is available from Exidy and many other software makers.

I wanted user programmability. The Sorcerer's unique plug-in ROM PAC™ Cartridges contain programming languages such as Standard (Altair 8k*) BASIC, Assembler and Editor (so I can develop system software), operating systems such as DOS (so I can also use FORTRAN and COBOL) and applications packages such as Word Processor.

* Altair is a trademark of Pertec Computer Corp.

I wanted graphics, and the Sorcerer is super. Its 256 character set—more than any other personal computer—includes 128 graphic symbols that I can define.

I wanted high resolution video. With 122,880 points in a 512 x 240 format, I get the most detailed illustrations.

I wanted to display more information. The Sorcerer displays 1920 characters in 30 lines of 64 characters —equal to a double-spaced typed page.

I wanted a full, professional keyboard. The Sorcerer's 79-key data processing keyboard provides designated graphics, the complete ASCII character set in upper and lower case, and a 16-key numeric pad.

I wanted memory. The 12k of ROM holds a Power-On Monitor and Standard BASIC; the 8k of RAM is internally expandable to 32k.

I wanted expandability. Serial and parallel I/Os are built in, and the optional 6-slot S-100 expansion unit lets my system grow.

I wanted a computer that's easy enough for children to use. I just connect my Sorcerer to a video display and a cassette tape recorder, and if I have any questions the easy-to-understand Operation and BASIC Porgramming manuals have the answers.

I wanted to buy from an experienced manufacturer. In five years Exidy has become the third largest producer of microprocessor-based video arcade games.

I wanted to spend less than a thousand bucks. (This is where Exidy does a little magic.) My Sorcerer cost me $895!

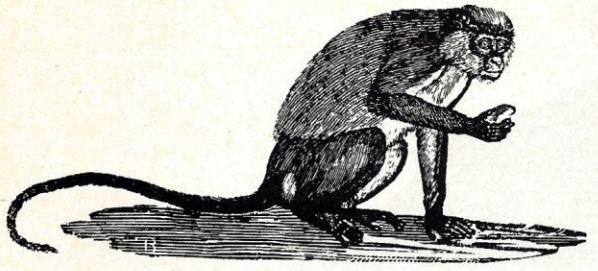
Now, what are ***you*** waiting for?

Call Exidy for the name of your nearest dealer. (408) 736-2110. Or write Exidy, 969 W. Maude Ave., Sunnyvale, CA, 94086.

Exidy inc.

CIRCLE 198 ON READER SERVICE CARD

Puzzles & Problems



Monkey and Banana

A rope over the top of a fence has the same length on each side. Weighs 1/3 lb. per ft. On one end hangs a monkey holding a banana, and on the other end a weight equal to the weight of the monkey. The banana weighs 2 oz. per inch. The rope is as long as the age of the monkey, and the weight of the monkey (in ounces) is as much as the age of the monkey's mother. The combined ages of monkey and mother are 30 years. 1/2 the weight of the monkey, plus the weight of the banana, is 1/4 as much as the weight of the weight and the weight of the rope. The monkey's mother is 1/2 as old as the monkey will be when it is 3 times as old as its mother was when she was 1/2 as old as the monkey will be when it is as old as its mother will be when she is 4 times as old as the monkey was when it was twice as old as its mother was when she was 1/3 as old as the monkey was when it was as old as its mother was when she was 3 times as old as the monkey was when it was 1/4 as old as it is now. How long is the banana?

Yes, I know this has been around for ages, but every once in a while I rummage around in my old stuff to see what's still there. This was, and I had some fun with it. Maybe you will too. —DHA

Perfect Numbers

Have you ever wondered what a "perfect number" was? Did you ever *care* what a perfect number was? A perfect number is defined as one which equals the sum of its factors. Thus, six is a perfect number - the factors of six are one, two, and three, and 1+2+3=6 (This doesn't count 6 as being a factor of itself).

Since these numbers are few and far between, they are a natural for a computer to find. A good problem for a novice computer programmer is to write a routine to find perfect numbers. Or better yet, to find them efficiently. Here's one such program with which you can amaze your friends by telling them that your computer is working on an ancient math problem discovered by the Greeks.

Stephen P. Renwick
10 Pine Street
Portland, ME 04102

Daily Bread

A garrison had bread for 11 days. If there had been 400 more men, each man's daily share would have been two ounces less; if there had been 600 less men, each man's daily share could have been increased by two ounces, and the bread would then have lasted 12 days. How many pounds of bread did the garrison have?

Thinkers' Corner

Layman E. Allen © 1977

SET THEORY PUZZLES

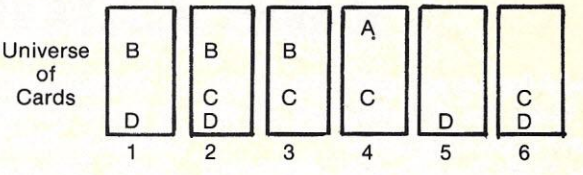
How many of the problems (a) through (f) below can be solved by forming an expression that will name the number of cards in the universe that is listed as the GOAL? (Suppose that each letter and other symbol in the problems below is imprinted on a disc.)

The expression must use:

(1) all of the discs in the REQUIRED column,

(2) as many of the discs in PERMITTED as you wish, and

(3) at most one of the discs in RESOURCES.



Examples:

The expression A names 1 card (4).
The expression A′ names 5 cards (1,2,3,5,6).
The expression B ∩ C names 2 cards (2,3).
The expression B ∪ C names 5 cards (1,2,3,4,6).
The expression C-B names 2 cards (4,6).

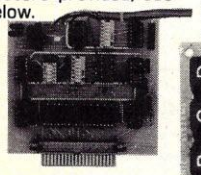
Problem	GOAL	REQUIRED	PERMITTED	RESOURCES
[a]	3		A D --	A C ∩ -
[b]	2	A	B U	A B C - ′
[c]	5		B C -	B C D ∩ ′
[d]	6	U	A B B D	A B D U ∩
[e]	0	D -	B C	B C U ∩
[f]	1	B	C D U ∩	B C D U ∩

If you enjoy this kind of puzzle, you might like playing ON-SETS: The Game of Set Theory. Free information about this and other instructional games is available upon request from Learning Games Associates, 1490-S South Blvd., Ann Arbor, Michigan 48104.

a) C-A
b) (BUA)′
c) (B-C)′
d) AUBUD
e) B-(CUD)
f) B ∩ (D ∩ C)

TRS-80 SERIAL I/O E.S.

• RS-232 compatible • Can be used with or without the expansion bus • On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line. Board only $19.95 Part No. 8010, with parts $59.95 Part No. 8010A, assembled $79.95 Part No. 8010C. No connectors provided, see below.

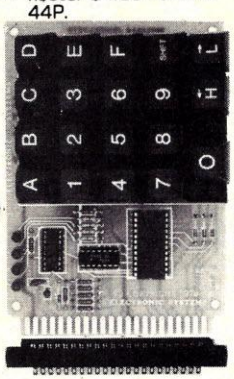


EIA/RS-232 connector Part No. DB25P $6.00, with 9', 8 conductor cable $10.95 Part No. DB25P9.

3' ribbon cable with attached connectors to fit TRS-80 and our serial board $19.95 Part No. 3CAB40.

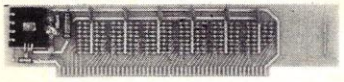
HEX ENCODED KEYBOARD E.S.

This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, 8-4-2-1 and STROBE are debounced and available in true and complement form. Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX-3A. 44 pin edge connector $4.00 Part No. 44P.



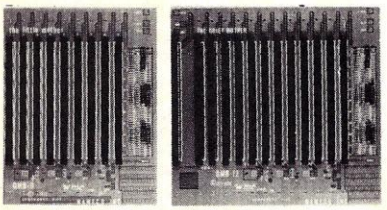
S-100 BUS ACTIVE TERMINATOR *

Board only $14.95 Part No. 900, with parts $24.95 Part No. 900A



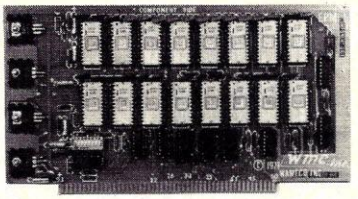
9 AND 13 SLOT MOTHER BOARDS wmc inc.

All traces are reflow solder covered and both sides are solder masked. The connectors used on these boards are the IMSAI™ type (.125" between pins, .250" between rows). Spacing between connectors is .750". All lines, except power and ground, have a passive RC network termination available. There is a kluge area available that will accept two 40 pin sockets and one 36 pin socket. The circuitry for supplying three separate regulated voltages to the kluge area is contained on the board. Part No. QMB-12 $40 bare, $105 kit, $120 assembled. Part No. QMB-9 $35 bare, $90 kit, $105 assembled.



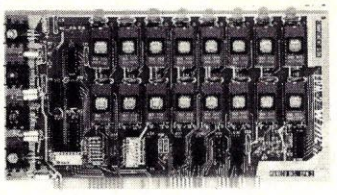
4K EPROM wmc inc.

This board is designed to operate with any speed or power 1702A. Addressable in 4K byte increments and can be configured to occupy either 2K or 4K segments. It can be populated one memory chip at a time. Bare board $30, board with parts $200, assembled $230. Part No. EPM-1



16K OR 32K EPROM wmc inc.

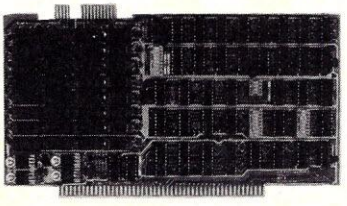
Designed to operate with any speed or power 2708 or single voltage (+5V) 2716. Addressable in 4K increments and can occupy multiples of 4K. It can be populated one memory chip at a time. Has bank addressing and Phantom Disable. The board comes with an exclusive software program that can be placed in a 2708 or 2716 that will, when used in conjunction with a RAM memory board, check out every line on the EPM-2. Bare board $30, board with parts with 2708 $455, assembled $485. Board with parts with 2716 $1,225, assembled $1,255. Part No. EPM-2



PIICEON

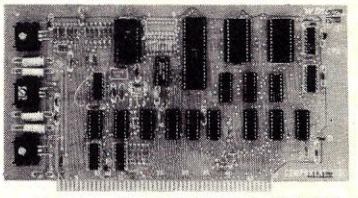
65K DYNAMIC RAM

Main memory for microcomputers, intelligent terminals, business systems, medical systems, and OEM systems. • High density random access memory 48K bytes or 64K bytes • Fully buffered • S-100 bus compatible • Low power (dynamic memory) • Transparent refresh • Digital delay line techniques for reliable operation • Multiple boards allowed using hardware or software controlled bank select • "Phantom" signal for RAM/ROM overlap • All boards are fully tested prior to shipment. Operating System test and extensive bit pattern testing. • Works directly in 8080A processors or Z-80 environment at 2MHz • Currently used by industry • 1 year warranty. Only available assembled and tested with 48K $1,250 Part No. 48K, or with 65K $1,475 Part No. 65K



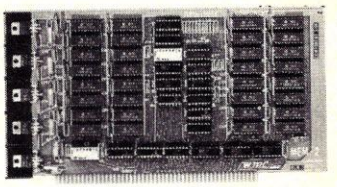
8080A CPU (With Eight Level Victor Interrupt Capability) wmc inc.

Uses the 8080A and the 8224 clock chip. The crystal frequency used is 18 MHz and the vector interrupt chip is the 8214. The board will function normally without the interrupt circuitry. When the interrupt circuitry is built up, the board will respond to eight levels of interrupts. Designed to be a plug-in replacement for the IMSAI CPU board and will work in other computers with the appropriate modifications made to the ribbon cable connector pin out from the front panel. The board will work in systems without a front panel if the system has a PROM board that simulates the functions of the front panel. Bare board $30, with parts $185, assembled $220. Part No. CPU-1



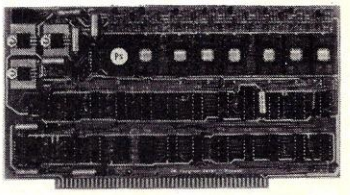
16K STATIC RAM wmc inc.

Operates with any speed or power 2114. All input and output lines are fully buffered. Addressable in 4K byte increments. If the system has a front panel, the board will allow itself to be protected. If there is no front panel, the board will not allow itself to be protected. The board has Bank Address capability, Phantom Disable, MWRITE, and selectable wait states. Bare board $30, board with parts $665. Part No. MEM2



8K EPROM PIICEON

Saves programs on PROM permanently (until erased via UV light) up to 8K bytes. Programs may be directly run from the program saver such as fixed routines or assemblers. • S-100 bus compatible • Room for 8K bytes of EPROM non-volatile memory (2708's). • On-board PROM programming • Address relocation of each 4K or memory to any 4K boundary within 64K • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software available • Solder mask both sides • Full silkscreen for easy assembly. Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.



To Order: Mention part number, description, and price. In USA, shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling, no C.O.D.'s. Checks and money orders must be payable in US dollars. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. Prices are in US dollars. No open accounts. To eliminate tariff in Canada boxes are marked "Computer Parts." Dealer inquiries invited. 24 Hour Order Line: (408) 226-4064

* Circuits designed by John Bell

For free catalog including parts lists and schematics, send a self-addressed stamped envelope.

ELECTRONIC SYSTEMS Dept. X, P.O. Box 21638, San Jose, CA. USA 95151

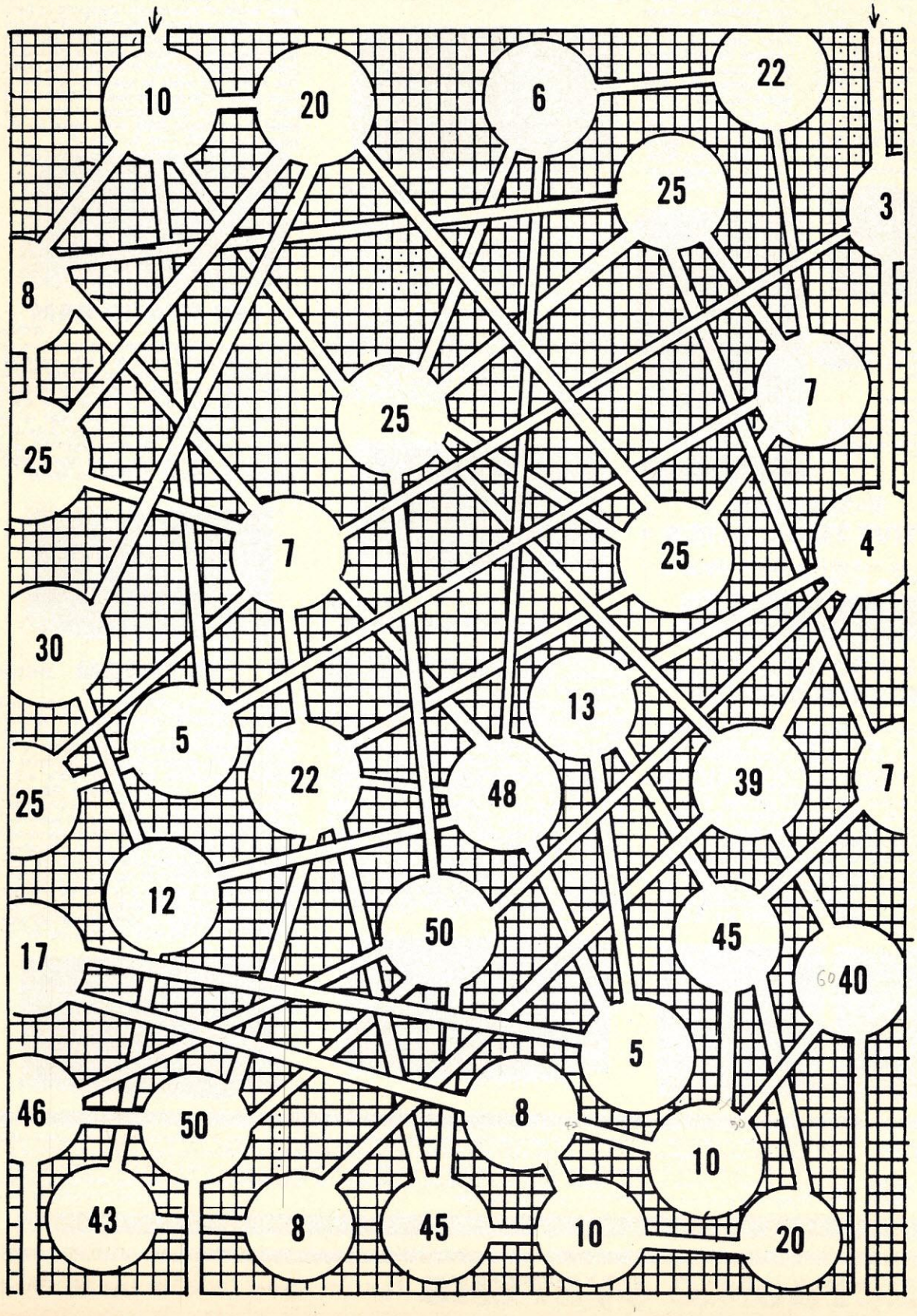
CIRCLE 118 ON READER SERVICE CARD

PINBALL MAZE

Start this maze at either of the two arrows at top and bounce from one "bumper" to another. Your object is to get a score of exactly 100 and then get out at one of the three bottom exits. You may not use any number more than once. No tilting please!

You might want to try to write a computer program to solve this maze but be warned: it is a challenging, non-trivial problem.

Reprinted from *Challenging Mazes* by Lee Daniel Quinn published by Dover Publications. Copyright 1975 by L.D. Quinn.

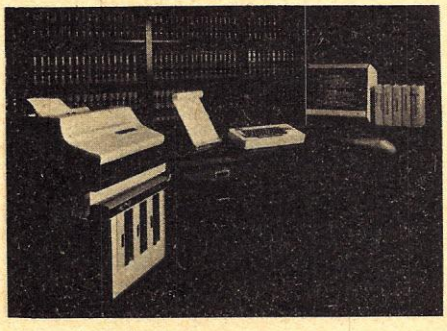


Compleat Computer Catalogue

We welcome entries from readers for the "Compleat Computer Catalogue" on any item related, even distantly, to computers. Please include the name of the item, a brief evaluative description, price, and complete source data. If it is an item you obtained over one year ago, please check with the source to make sure it is still available at the quoted price.

Send contributions to "The Compleat Computer Catalogue," *Creative Computing*, P.O. Box 789-M, Morristown, NJ 07960.

COMPUTERS



ALPHA SYSTEM 7

Alpha Professional Systems, Inc. announces the availability of the ALPHA SYSTEM 7, a word processor designed specifically for law office use, incorporating a full fledged Z80 microcomputer system with 56K of fully static RAM.

The word processing system utilizes a high resolution 22mHz. 15″ video display and a high speed 45 CPS. daisy wheel letter quality printer. Margins, justification, pitch, centering, boldface type, line spacing, headings, underlining and automatic page numbering are under program control. Type style and ribbons are available in a wide variety and are interchangeable.

Storage media is dual 8″ flexible IBM 3740 format disks with a capacity of well over 100 pages of text per disk. (Third disk drive is available at extra cost).

The system allows automatic search and replacement of any variable such as client name, dates, locations and amounts. Once a document is entered, it need never be entered again as only the variables are changed. For example, a 25 page pleading can be changed, as to any name, date, sum or any other variable which occurs, in less than two seconds.

Pages, paragraphs, lines, words or characters can be inserted, deleted or changed with the system automatically opening or closing text to accommodate the inserted, deleted or moved text. The results are instantly visible on the screen.

The legal time and cost system is designed to accommodate from one to ten or more attorneys. All accounts receivable and trust account ledgers are stored, and statements may be viewed or printed at any time. Numerous management reports are available including aged reports by matter, client, attorney and other variables.

A Users Group is forming and its newsletter will provide a catalog of available pleadings, contracts, wills and trusts, correspondence and other documents. Only a nominal copying and mailing charge will apply.

Lease/Purchase prices are as low as $300.00 per month.

Inquiries from qualified dealers are invited.

For additional information contact ALPHA PROFESSIONAL SYSTEMS, INC., 9465 Wilshire Blvd., Suite 518, Beverly Hills, California, (213) 272-3032.

CIRCLE 210 ON READER SERVICE CARD

THE "ACCOUNTANT"

Computer Data Systems, Inc., of Wilmington, Delaware has announced immediate availability of their newest marketing concept entitled, the "Accountant." It is a complete turn-key system complete with a Versatile 4 Dual Drive computer, an Impact Printer, application business software and a Formica table on rollaway casters for convenient moving.

The business software includes a General Ledger which will set up a chart of accounts

and general journal, and will produce a Trial Balance, Income statement and Balance Sheet. It will automatically post transactions to the Ledger and produce an audit trail of transactions. Accounts Payable programs will produce Accounts Payable statements by vendor, date, or through a range of dates and project the cash necessary to fulfill these obligations. It will also print checks and mailing stubs and journalize transactions so they will be processed by the Microledger. Accounts receivable programs produces Accounts receivable statements by customer, date, or range of dates as well as Aged Accounts Receivables report. It will report cash projections from collections and journalize transactions for processing in the Microledger. The Inventory programs produce a status report, audit trail of issue and receive transactions. It also provides materials, job cost analysis and year to date usage. Computes average LIFO costs and EOQ's. Also journalizes transactions for the Microledger. The Personnel/Payroll programs maintains personnel records and computes Payroll register for hourly and salaried employees. It computes and prints paychecks, Quarterly's, 941's, and yearly W-2 forms. Also computes Labor Job Cost Analysis and journalizes payroll transactions for the Microledger. Under $6000.

Computer Data Systems, Inc., at 5460 Fairmont Drive, Wilmington, Delaware 19808. Telephone (302) 738-0933.

CIRCLE 211 ON READER SERVICE CARD

DURANGO SYSTEMS, INC., INTRODUCES THE "WORLD'S SMALLEST BIG COMPUTER"

SHE HAS THE WHOLE COMPUTER IN HER HANDS—This pretty secretary demonstrates the portability of the Durango F-85 desk top computer. Its manufacturer, Durango Systems, Inc., 10101 Bubb Rd., Cupertino, CA 95014, calls the F-85 "the world's smallest big computer" because it incorporates disc drive, cathode ray tube display and keyboard into a single portable unit. The F-85 can be plugged into any 110-volt socket and be ready for operation. The computer is designed to perform a number of small business functions and sells for $13,520.

CIRCLE 212 ON READER SERVICE CARD

NEW COMPUTER IS SS50 COMPATIBLE

A new, low cost Microcomputer System with SS50 Bus compatibility has been announced by JF Products Co. Designated the JF68, the unit is based on the powerful 6800 Microprocessor.

The CPU board contains a powerful 2K operating system called JFBUG (c) that is resident in ROM memory. Existing Software for any MIKBUG (c) type system will execute without modification. An RS-232 or Current Loop interface up to 9600 BAUD is accomplished through a Serial I/O card included in the system price. An audio Cassette interface using the "Kansas City Standard" recording technique is located on a single I/O card. "LOAD" and "SAVE" commands incorporated in the JFBUG Monitor, contain all of the necessary Software to read and record programs on any low cost Cassette recorder.

The JF68 Computer System is available in Kit form for $549.95 or fully Assembled and Tested for $749.95. For additional information contact JF PRODUCTS, 1441-5 Pomona Rd., Corona Ca. 91720.

CIRCLE 219 ON READER SERVICE CARD

780K BYTES ON-LINE STORAGE IMSAI'S VDP-4X INTEGRATED SYSTEMS

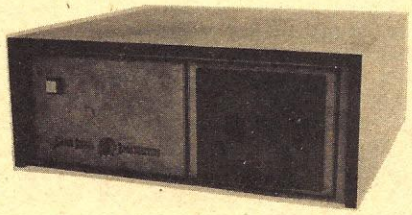
IMSAI MANUFACTURING CORPORATION announces SERIES VDP-4X Video Data Processor. Three versions, the VDP-40, VDP-42 and VDP-44, provide a disk storage capacity of 180K, 400K and 780K bytes, respectively.

A fully integrated system, the VDP-4X features an 8085 microprocessor, 32K/64K RAM, dual 5¼-inch floppy disks, 9-inch CRT, keyboard and serial I/O in a desk-top cabinet.

IMSAI's multi-disk operating system (IMDOS) is provided with the VDP-4X and has a large number of utilities — including an 8080/85 assembler, video/context editor, dynamic software debugging program and floppy disk system diagnostic program.

780K bytes on mini-floppies is achieved by combining the IMDOS disk formats with double density, 77-track mini-disk drives. IMSAI MANUFACTURING CORPORATION, 14860 Wicks Blvd., San Leandro, CA 94577, (415) 483-2093, TWX: 910-366-7287.

CIRCLE 213 ON READER SERVICE CARD



SMOKE SIGNAL BROADCASTING INTRODUCES NEW 6800-BASED MICROCOMPUTER

A new high performance dual-floppy microcomputer, featuring SS-50 BUS compatibility and a new controller design, has been introduced by Smoke Signal Broadcasting, designers and manufacturers of small business computer systems.

The new "CHIEFTAIN" microcomputer is a versatile, general purpose system based on the powerful 6800 microprocessor with 32K of static RAM. Standard features also include two serial I/O ports, two mini-floppies and the compatible DOS-68 disk operating system.

Increased reliability is obtained through the use of gold connectors to eliminate continual re-seating of boards and a cooling fan to extend component life.

The new microcomputer allows up to 60K of usable memory by adding two more slots. Disk storage can also be increased to four mini-floppies or four 8-inch floppies. $2595.

Smoke Signal Broadcasting, 6304 Yucca Street, Hollywood, CA 90028. (213) 462-5652.

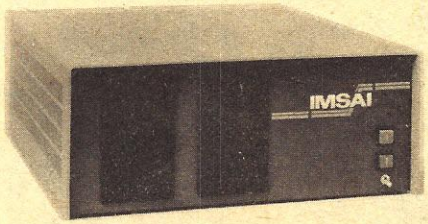
CIRCLE 214 ON READER SERVICE CARD

SYSTEM TWO DISK COMPUTER

The Cromemco System Two Disk Computer comes equipped with Cromemco's well-known 4-MHz Z-80, CPU card; two 5-inch floppy disk drives; Cromemco's versatile disk controller; 32 kilobytes of RAM memory (comprised of two Cromemco 16KZ-W memory cards); the proven Z-2 chassis with 21-slot motherboard; and a 30-amp power supply.

Cromemco provides a wide range of quality software support for the System Two. Currently available software includes a FORTRAN IV compiler, a 16K Extended BASIC, and a Z-80 Macro Assembler. All software is available on standard, IBM-format, soft-sectored mini diskettes. $3990. Cromemco, Inc., 280 Bernardo Avenue, Mountain View, CA 94040; (415) 964-7400.

CIRCLE 215 ON READER SERVICE CARD



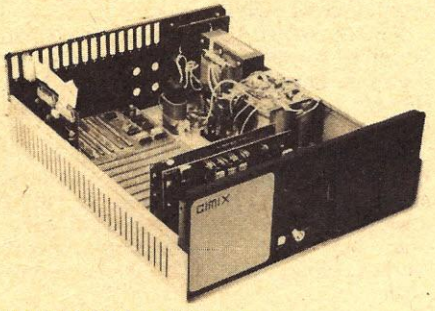
BASIC COMPUTER SYSTEM WITH 780K BYTES

IMSAI MANUFACTURING CORPORATION introduces SERIES PCS-4X Personal Computer Systems. An integrated system, the PCS-4X features an 8085 microprocessor, 32K/64K RAM, dual 5¼-inch floppy disks and serial and parallel I/O in a desk top cabinet. Three versions, the PCS-40, PCS-42 and PCS-44, provide a disk storage capacity of 180K, 400K and 780K bytes, respectively.

For a complete computer system, the user need only add a terminal. Or the system may be completed by adding a keyboard, video interface board and video monitor. Expansion capability allows the addition of interface boards, RAM and disk drives. IMSAI's multi-disk operating system, IMDOS, comes with the PCS-4X and has a large number of utilities —

including an 8085 assembler, video/context editor, dynamic software debugging program and floppy disk system diagnostic program. IMSAI Manufacturing Corporation, 14860 Wicks Boulevard, San Leandro, California 94577, (415) 483-2093.

CIRCLE 216 ON READER SERVICE CARD



NEW 6800-BASED COMPUTER SYSTEM

GIMIX INC., the company that manufactures telephone industry products and the GHOST power control systems, is delivering its complete professional quality system 68 microcomputer. It features a ferro-resonant constant voltage power supply; an SS-50 motherboard; a 6800 CPU board that holds 4-2798s and 3 independent programmable software timers; and the unique GIMIX 16K software readdressable static RAM boards orgainized into four separately controllable 4K blocks, which allow the user to have as much memory as can be contained in the mainframe. DIP switch features allow use of existing SWTP and MSI compatible software.

This system is video based using the GIMIX video board and advanced GMX-BUG 3K ROM monitor that contains the standard utility functions plus routines that facilitate softward development.

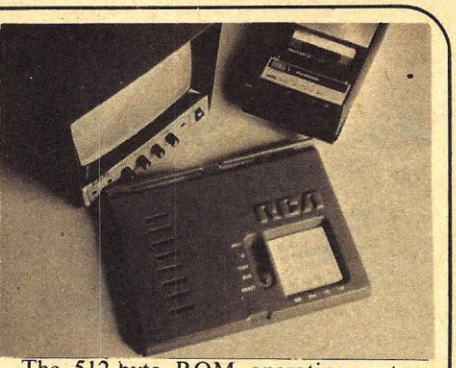
Gimix Inc., 1337 W. 37th Place, Chicago, IL 60609. Attn: Richard Don.

CIRCLE 217 ON READER SERVICE CARD

VIP PERSONAL COMPUTER OFFERED BY RCA

An expandable, low-cost hobbyist computer kit, called COSMAC VIP — Video Interface Processor, is available from RCA Solid State Division to permit the hobbyist to create and play video games, generate graphics and develop microprocessor control functions. Priced at $249.00 fully assembled, the VIP is a complete computer on a printed circuit card, offering a powerful, uncluttered, complete operating system in only 4K bits of ROM. VIP's output directly interfaces with a monochrome CRT display or, when used with an FCC-approved modulator, a TV receiver. Programs can be generated and then stored in an audio cassette tape recorder for easy retrieval and use.

The heart of the VIP is RCA's CDP1802 microprocessor whose CMOS technology and 8-bit elegant COSMAC architecture have established it in applications as varied as TV games, automotive engine controls and factory process controls.



The 512-byte ROM operating system offers the hobbyist benefits in that it simplifies such tasks as loading a program into the RAM via the hexadecimal keyboard, recording RAM contents on cassette tapes, transferring tape-recorded programs into RAM, displaying memory bytes in hexadecimal format on a CRT, stepping through RAM contents, and examining contents of the CDP1802 CPU registers.

RCA COSMAC VIP Marketing, New Holland Avenue, Lancaster, PA 17604, attn: Rick Simpson. (717) 291-5848.

CIRCLE 218 ON READER SERVICE CARD

VIDEOBRAIN ANNOUNCES PRICE REDUCTION

VideoBrain Computer Company has announced an immediate price reduction for its entire home computer line. The suggested retail price for each of the five existing VideoBrain home computer systems has been dropped by $150 to $200.

SP-302 Printer

$575, 1-10 quantities

STANDARD FEATURES:

- 115-230 VAC, 50/60 Hz
- RS-232 and 20ma loop inputs.
- Microprocessor Controller.
- Double width printing, tabs double and triple space format.
- 40 Column Impact Printing.
- 5x7 Dot Matrix, Standard 64 Character ASCII Subset.
- Internal 40 Character Buffer.
- 50 CPS Printing Rate.
- Multi-copy Capability.
- Substantial OEM discounts

syntest CORPORATION
169 Millham Street, Marlboro, MA 01752
(617) 481-7827 ● TWX 710-390-7659

CIRCLE 200 ON READER SERVICE CARD

Build The World's Most Powerful 8-Bit Computer

Featuring The Famous Intel 8085!

Explorer/85™

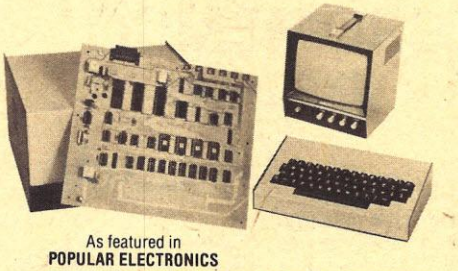
Starting for just $129.95 you can now build yourself a sophisticated, state-of-the-art computer that can be expanded to a level suitable for industrial, business and commercial use. You learn as you go . . . in small, easy-to-understand, inexpensive levels!

- ***Features Intel 8085 cpu/100% compatible with 8080A software!***
- ***Onboard S-100 bus (up to 6 slots)!***
- ***Onboard RAM and ROM expansion!***
- ***Built-in deluxe 2K Monitor/Operating ROM!***
- ***Cassette/RS 232 or 20 ma./4-1/2 8-bit parallel I/O and timer all on beginner's Level "A" system!***

EXPLORER/85 gives you "big computer" features immediately, without turning you into an appliance operator, doomed to run pre-developed software for life. Simply connect EXPLORER to a terminal, video monitor or tv set and 8 volt power supply and start running programs, the very first night! Level "A" teaches you machine language and computer fundamentals. It lets you run exercise programs including programs to examine the cpu registers, examine memory, fill memory, move memory and make up games. You can load and play back these programs on an ordinary tape cassette—and display your efforts on any tv screen, video monitor or printer. ($8.95 RF modulator required for tv use.) The simplified architecture of the Intel 8085 makes EXPLORER far easier to understand than computers using the older, more complex but less powerful 8080A. Then, when you're ready, EXPLORER can be expanded—by you—to rival the power of any 8-bit computer on earth. Or you can customize it to perform a dedicated task, thanks to onboard prototyping, RAM and ROM expansion capabilities.

LEVEL "A" SPECIFICATIONS

EXPLORER's Level "A" system features an advanced Intel 8085 cpu, which is 50% faster than its 8080A predecessor, yet 100% compatible with 8080A software . . . which, you'll discover, exists by the ton. "Big computer" features include an 8355 ROM with 2K deluxe monitor/operating system which has two programmable 8-bit bi-directional parallel I/O ports; built-in cassette interface with tape control circuitry to allow labeling cassette files, and commands which include: "display contents of memory," "run at user location (go to)," "insert data," "move contents of memory," "examine registers individually or all," fill command (to fill the contents of memory with any variable), automatic baud rate selection, programmable characters per line display output format, and more! An 8155 RAM—I/O chip contains 256 bytes of RAM, two programmable 8-bit bi-directional and one programmable 6-bit bi-directional I/O ports plus programmable 14-bit binary counter/timer, user interrupt and reset switches. Onboard expansion provisions exist for up to six S-100 boards, 4K of RAM and 8K of ROM, PROM or EPROM.



As featured in
POPULAR ELECTRONICS
EXPLORER/85 shown with Video Monitor and Keyboard/Video Terminal.

CHOICE OF HEX KEYPAD OR TERMINAL INPUT

If you plan to customize EXPLORER for dedicated use, we recommend that you order hex keypad input. But, if you are planning to go whole hog and blow EXPLORER up into a full size, state-of-the-art system with 8K or extended basic (coming soon), up to 64K of memory, floppy disks, telephone interface, printers, and all sorts of S-100 plug-ins—you'll be better off with the Keyboard/Video Terminal input. The $149.95 EXPLORER Keyboard/Video Terminal includes full ASCII decoding with 128 ASCII upper/lower case set, 96 printable characters, onboard regulators and selectable display formats—32x16 for tv set or 64x16 for video monitor (not included).

EXPAND EXPLORER, LEVEL-BY-LEVEL

Level "B", at $49.95, adds S-100 signals plus onboard RAM/ROM decoding. Includes all parts necessary to generate the signals for S-100 bus accessories. Just add two S-100 bus connectors and you have a complete S-100 compatible computer with a world of add-ons at your fingertips. Choose from hundreds of products to satisfy your individual needs. Level "B" kit also includes the address decoders for onboard RAM and ROM expansion, which are addressable anywhere in the 65K field.

Level "C" expansion, at $39.95, expands the S-100 bus to allow a total of six S-100 cards to be plugged into EXPLORER's motherboard and contained in EXPLORER's steel cabinet. Includes all hardware, mounting brackets, board guides, etc. Just add the number of S-100 bus connectors you need.

Level "D" expansion, at $69.95, gives you 4K of onboard static RAM utilizing 2114 IC's. Your board will also accept four 2716 EPROM's, which can be purchased separately. You now have an advanced mainframe that can be customized with the peripherals of your choice to fit any (or all) specific requirements. Each level of EXPLORER is separately regulated for the ultimate in stability. Factory service is available from Netronics. **Order your EXPLORER today!**

ORDER FROM THIS COUPON TODAY!

Netronics R&D Ltd., Dept CC-2,333 Litchfield Road, New Milford, CT 06676

- ☐ Level "A" EXPLORER/85 kit (specify ☐ terminal or ☐ hex keypad input), $129.95 plus $3 p&h.
- ☐ Power Supply kit, 5 amp, ±8 volt, $34.95 plus $2 p&h.
- ☐ Intel 8085 User's Manual, $7.50 ppd.
- ☐ ASCII Keyboard/Video Terminal kit, $149.95 plus $3 p&h.
- ☐ Hex Keypad kit for hex version, $69.95 plus $2 p&h.
- ☐ Level "B" S-100/Onboard RAM/ROM Decoder kit (less S-100 connectors), $49.95 plus $2 p&h.
- ☐ Level "C" S-100 5-Card Expander kit (less connectors), $39.95 plus $2 p&h.
- ☐ S-100 Bus Connectors (gold), $4.85 each.
- ☐ Level "D" 4K Onboard RAM kit, $69.95 plus $2 p&h.
- ☐ Deluxe Steel Cabinet for EXPLORER/85, $39.95 plus $3 p&h.
- ☐ Deluxe Steel Cabinet for Keyboard/Video Terminal, $19.95 plus $2.50 p&h.
- ☐ RF Modulator kit, $8.95 ppd.
- ☐ Total Enclosed (Conn. res. add tax) $_____
- ☐ **VISA** ☐ **Master Charge** **Exp. Date** _____

Account # _____

PHONE ORDERS CALL (203) 354-9375

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Name _____

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State _____ Zip _____

DEALER INQUIRIES INVITED

CIRCLE 159 ON READER SERVICE CARD

NORTH STAR

Now DOUBLE or SINGLE Density Floppy Disk!

COMPLETE MINIFLOPPY DISK SYSTEM, single density w/BASIC and drive, Kit, List $699 **$529**

Double density version of above, Kit List $699 (order 01-7735-1) **$589**

Factory assembled, double density List $799 (01-7745-1) **$689**

BUY NOW . . .

HORIZON 1, single density, Kit List $1599 (01-3501-0) **$1249**

Assembled version of above, List $1899 **$1499**

Double density version, Kit, List $1599 **$1349**

Double density, Assembled, List $1899 **$1599**

HORIZON 2, single density, Kit List $1999 (order as 01-3502-0) **$1599**

Assembled version of above, List $2349 **$1839**

Double density version, Kit, List $1999 **$1699**

Double density, Assembled, List $2349 **$1939**

CROMEMCO
SYSTEM 3

List $5990 OUR CASH PRICE **$4999**

Features 4 MHz CPU, 32K of RAM, dual PerSci floppy disk drive (and provision for installing two additional drives), RS232C Interface, Printer Interface; assembled and tested, ready to use. (Order as 02-5503-0)

System 2 — Similar to System 3, but features dual minifloppies, List $3990 (order as 02-5502-0) **$3390**

Z-2 Computer System, Kit for rack mounting, Z-80 processor, 21 slots, power supply, front cover panel List $595 (order as 02-5301-0) 499

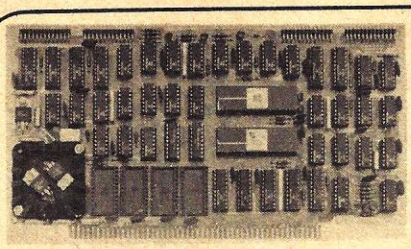
Assembled and Tested, incl. fan and all edge connectors, List $995 (order as 02-5401-0) 845

Z-2D Disk Computer System, Kit Similar to Z-2, but comes with floppy disk controller, DOS, and minifloppy disk drive. A complete system with the addition of a RAM Board, List $1495 (02-5302-0) 1270

Assembled/Tested List $2095 (order as 02-5402-0) 1780

MiniMicroMart, Inc.
1618 James St., Syracuse NY 13203
(315) 422-4467

CIRCLE 176 ON READER SERVICE CARD



4 MHz SINGLE CARD COMPUTER

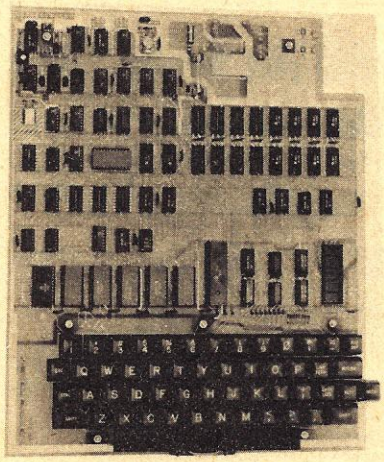
Cromemco's Single Card Computer is a complete computer which brings the power of the Z-80 and the flexibility of the S-100 bus to the dedicated computer environment.

The card offers 4 MHz operation, 8K bytes of on-board 2716 PROM, and 1K byte of static RAM memory. This stand-alone card also provides an RS-232 (or 20mA current loop) serial interface with programmable baud rates to 76,800, 24 bits of bidirectional parallel I/O, 5 programmable timers and vectored interrupts.

Cromemco's Z-80 Monitor and 3K Control BASIC are available in 2716 ROM for use with the Single Card Computer.

The Single Card Computer is available in kit for $395 and assembled and tested for $450. The Monitor and Control BASIC are available in two ROMs for $90. For additional information, please contact Cromemco, Inc., 280 Bernardo Avenue, Mountain View, CA 94040, (415) 964-7400.

CIRCLE 220 ON READER SERVICE CARD



OHIO SCIENTIFIC PERSONAL COMPUTER SYSTEMS

Ohio Scientific, Inc., has just introduced Superboard II, the world's first complete personal computer system contained entirely on only one board.

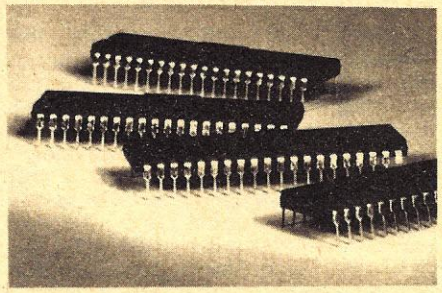
Features includes 8K of BASIC-in-ROM, up to 8K of static RAM, an ultra-fast 6502 microprocessor, a full 53-key computer keyboard with upper/lower case and user programmability, a video display interface with graphics, and a Kansas City standard audio cassette interface, plus full machine code monitor and I/O utilities in ROM. The BASIC-in-ROM is full-feature BASIC that runs faster than currently available personal computers and all 8080-based business computers. The video display is direct access with 1K of dedicated memory in addition to user memory.

Ohio Scientific's Superboard II was designed for the first-time hobbyist, student, or serious computer user so it comes without a power supply or case. Any + 5 volt DC 3 amp supply powers it up. The Superboard II packs in a lot of personal computing for an extremely low suggested retail price of $279.

Superboard II is also available as Challenger 1P complete with power supply (on the same board) and case for only $349. (Export prices for either model are slightly higher).

For details on where to buy Superboard II or Challenger 1P, or for complete information on other Ohio Scientific microcomputer systems write: Ohio Scientific, Inc., 1333 S. Chillicothe Road, Aurora, Ohio, 44202, U.S.A. (216) 562-3101.

CIRCLE 221 ON READER SERVICE CARD



PASCAL PROCESSOR IS CAST IN SILICON BY WESTERN DIGITAL

Western Digital Corporation has developed a 16-bit computer chip set that directly executes Pascal object programs at least five times faster than is possible with conventional system software and eliminates the previously required host operating system and interpreter.

The company will sell its state-of-the-art development both as a chip set and as a packaged software development computer to both OEM's and personal computing stores.

Designated the Pascal MICRO-ENGINE™ product line, the chip set standardizes the version of Pascal, offered by the University of California at San Diego. UCSD's version is generally regarded by the computer industry as an excellent implementation language for business, industrial and computer aided instruction applications. It was derived from (and is source compatible with) the original Pascal developed in 1971 at the Swiss Institute of Technology.

The UCSD software system includes a complete Pascal operating system: Pascal compiler, Basic compiler, file manager, screen-oriented editor, debug program and graphics package, all written in the Pascal language.

UCSD Professor Ken Bowles, who has been deeply involved in development of Pascal in the U.S., feels that the Western Digital announcement should "go a long way toward boosting Pascal's popularity among the user community.

"We are very excited; we've been hoping this would happen," he said. "The original

version of Pascal was designed for teaching programming, and there were no provisions, for example, for using it with rotating disk storage files."

"We have attempted to outfit the language with these 'missing links' to make it commercially suitable," he continued.

Bowles noted that there are more users of UCSD's Pascal today than users of all other versions combined. Western Digital and UCSD have agreed to mutually support this LSI implementation as the true UCSD standard.

The chip set is comprised of four LSI (MOS) components:

An arithmetic chip that contains micro-instruction decode, ALU, and the register file.

A micro-sequencer chip that contains macro-instruction decode, portions of the control circuitry, micro-instruction counters, and I/O control logic.

Two MICROM chips (each 22 bits x 512) that contain the micro-instruction ROMs and micro-diagnostics.

Additional features of the MICRO-ENGINE chip set include user-defined bus configuration, four levels of interrupts, single- and multi-byte instructions, hardware floating point, stack architecture, 3.0 MHz four-phase clock (75 nanoseconds per phase), and a TTL-compatible three-state interface.

The desktop computer features the 16-bit MICROENGINE processor, 32K words (64K bytes) of RAM memory, full DMA control functions, fully-integrated floppy disk controller, two RS-232 asynchronous ports, and two 8-bit parallel ports.

The chip set (CP 9008B-01) is priced at $195 for a single set and is discounted to $97.50 each at 10,000 quantity. The development system carries a single unit suggested retail price of $2995 and an OEM single quantity price of $2495. Volume discounts are available. Both products will be available for shipment in the first quarter of 1979. Western Digital Corp., 3128 Red Hill Ave., Newport Beach, CA 92663.

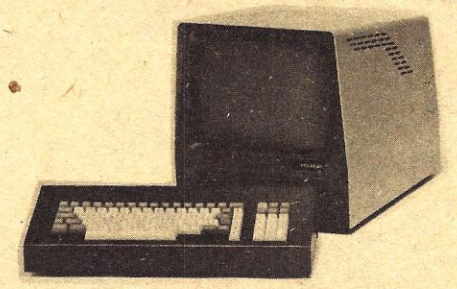
CIRCLE 222 ON READER SERVICE CARD

TERMINALS

NEW TERMINAL FEATURES 60-SECOND PART REPLACEMENT

The Teleray Division of Research Inc. ammounces the Series 10 CRT terminal line, incorporating a unique packaging, designed to drastically reduce downtime and service as significant user problems. Any of the terminal's modules (logic, monitor, power and keyboard assemblies) can be replaced as simply as a typewriter ribbon cartridge, in 60 seconds with no tools whatsoever.

The smart 1061—first of the Series 10 models—offers many useful *programmable* features, including 32 programmable functions, I/O and peripheral speeds, peripheral on/off and wide/narrow character display. It is a scroll or page mode editing machine with



cursor addressing, three-segment clear, insert/delete functions, and it transmits either in character mode or by line, message or page. The 1061 operates in format and protect modes with four-level highlighting (dim, blink, inverse video and underlining—programmable in any combination), and in transparent mode (control codes displayed).

Spare modules in reusable shock-resistant mailers expedite both shipping and service. The result is significantly lower downtime and service cost. A toll-free call to Teleray Service localizes the fault, a replacement module is shipped immediately, and the faulty one returned in the mailer.

Availability of the 1061 is five weeks ARO. It lists at $1090. OEM's start at $990, for one. Teleray Division Research Inc., P.O. Box 24064, Minneapolis, MN 55424. Contact Jim Anderson, (612) 941-3300.

CIRCLE 223 ON READER SERVICE CARD

Mike's
True-Interrupt Driven
TIME SHARING
for
NORTH STAR ★ COMPUTERS
Now included in our Program Library!

A bank-switching system which fully supports North Star DOS and Basic. Other languages to be supported in near future.

Program Library — $500 One Time Fee

Program Library included FREE with all purchases of $2,000.00 or more.

** Business Programs Require Addressable Cursor CRT **

2 User
Time Sharing System
1. Horizon II with 80KRAM
2. 2 ADM-3A's
3. IP-125 with 2K Buffer
4. Dual 8" Floppy Disk System
5. D.C. Hayes Modem
6. All connectors & cables
7. Program Library

$8995.00

HORIZON OWNERS
Move Up To
Timesharing
1. 48KRAM
2. ADM-3A
3. Program Library

$2100.00

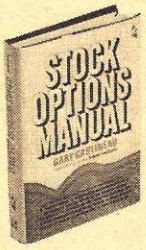
Requires 32K North Star RAM in Horizon Computer

8" Floppy Disks
$995 1st drive & controller
$795 each additional drive

Micro Mike's
905 Buchanan, Amarillo, Texas 79101
806-372-3633

CIRCLE 177 ON READER SERVICE CARD

Why settle for games when you can play for real profits . . . and here's the book to tell you how!



THE STOCK OPTIONS MANUAL, 2nd Ed.
By Gary Gastineau,
Manager, Options Portfolio Service, Kidder, Peabody & Company, Inc. (389 pp.)

Everyone in the options field is talking about the fantastic opportunities open to those with computer access! But only Gastineau talks about what **can** and **can't** be computerized and **how to do it!**

With its clearcut discussion of computer models and advisory services, it's a book YOU as a computer expert will find particularly intriguing! It . . .

- Analyzes all the major computer techniques for option evaluation and analysis.
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CIRCLE 201 ON READER SERVICE CARD

THE ULTIMATE TERMINAL SYSTEM

Southwest Technical Products is proud to announce what has to be the ultimate terminal system. This SWTPC engineered product is so functional, flexible, reliable and affordable it's almost unbelievable—but believe it anyway. It's true! The terminal, designated the CT-82, will work with almost any modem or computer system interfaced RS-232 serially from 50 thru 38,400 baud.

The CT-82 features over one hundred control functions operable from either the CT-82's keyboard or the computer's program. With its low price and graphics capability, it's ideal for business or hobby use.

The terminal design utilizes a Motorola 6802 microprocessor and 6845 CRT controller integrated into a modular system which is simple, reliable and easy to service. Its outstanding features are so numerous, they're impossible to list here. So write for complete details.

The CT-82 is offered in assembled form only and sells for $795.00 ppd. in the Continental U.S. Southwest Technical Products Corporation, 219 W. Rhapsody, San Antonio, Texas 78216, (512) 344-0241.

CIRCLE 224 ON READER SERVICE CARD

DAISYWHEEL PRINTER WORD PROCESSING AND PLOTTING WITH TRS-80 TRS-232 INTERFACE BY SMALL SYSTEMS SOFTWARE

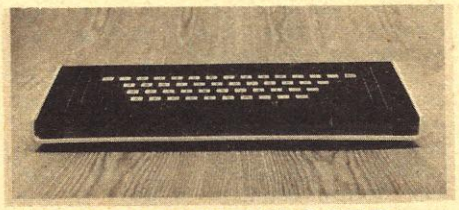
Now you can do high speed, high quality word processing and plotting using your TRS-80 and COMPUTER TEXTile's line of reconditioned daisywheel printers. All that is required to put a daisywheel printer "on line" with the TRS-80 is the TRS-232 interface developed by Small Systems Software.

The TRS-232 interface is a software driven transmit only device that plugs directly into the TRS-80 CPU box or the TRS-80 expansion interface. It gives TRS-80 owners the power to have beautiful low cost hard copy using a reconditioned daisywheel printer.

The TRS-232 interface sells for only $39.95 and may be purchased from COMPUTER TEXTile. THE ELECTRIC PENCIL word processing program is also now available on cassette for the TRS-80. COMPUTER TEXTile sells THE ELECTRIC PENCIL for the TRS-80 for only $99.95.

COMPUTER TEXTile sells reconditioned Diablo and Qume based printing terminals. The Diablo based terminal has the following features: HyType 1 printer mechanism, 82 key keyboard with numeric pad, RS232 interface with cable, ASCII encoded, 128 character buffer, switch selectable 10 to 12 pitch, complete graphics capability including 1/60th inch horizontal carriage control and 1/48th inch vertical carriage control. The printer is enclosed in a beige cabinet and sits on a black base with a chrome wheeled pedestal. The Qume based terminal is similar but uses the Qume 30 printer mechanism. The Qume has extended graphics capability in that it has a firmware package called "super-plot" which allows 1/120th inch horizontal carriage control. The Qume has a 228 character buffer and a few additional operator controls. The Diablo terminal sells for $1995 and the Qume is $2150. Forms tractors and pin feed platens are options available with either printer. Both units come with a limited 30 day warranty. COMPUTER TEXTile, 10960 Wilshire Blvd., Suite 1504, Los Angeles, CA 90024, telephone (213) 477-2196.

CIRCLE 225 ON READER SERVICE CARD



PROXIMITY KEYBOARD

You've seen those marvelous proximity panels on Sharp calculators and the Singer Touch-Tronic 2001 sewing machine; now TASA is making this technology available in a full keyboard for use with any computer. It has no mechanical moving parts and is sensitive only to the human body—metal or cloth will not activate a key. It has 51 keys, including shift, shift lock and control keys. Full 8-bit ASCII output with selectable positive or negative parity. Requires 12.5 to 20 v unregulated DC. The keyboard is completely sealed into a flat slab approx. ⅜" thick usable on any flat surface; it can also be used with an optional plastic support stand (as shown). keyboard $49.95, stand $12.00.

Touch Activated Switch Arrays, Inc., 2346 Walsh Ave., Santa Clara, CA 95050. (408) 247-2301.

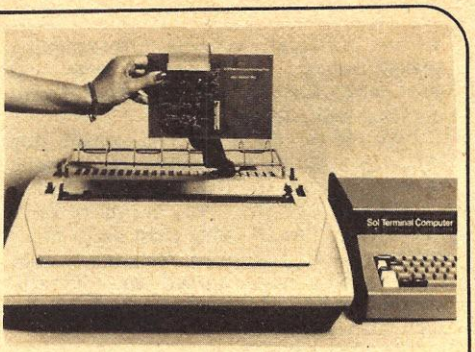
CIRCLE 226 ON READER SERVICE CARD

LARGE PROXIMITY KEYBOARD FOR THE HANDICAPPED

In this specially designed version of the TASA keyboard, CPCS has created a device which allows handicapped people to easily communicate with computers or other TV and tape recorder based learning devices. "Keys" are 1x1" with a 1" spacing inbetween. A standard keyboard can be used for programming.

CPCS, P.O. Box 185, Alviso, CA 95002. (408) 262-5181.

CIRCLE 227 ON READER SERVICE CARD



TWO NEW PRINTER INTERFACES

Two new printer interfaces for the Sol Computer have been announced by Processor Technology Corporation. Both increase the hard copy capability of the Sol computer.

Sol Hytype I mounts inside any Diablo Series 1200 Printer connecting it directly to the back of the Sol. Similarly the Sol Hytype II Printer Interface works with the Diablo Series 1300 Printer. The installation package includes the fully assembled, tested and burned-in printed circuit board, software, all cables and mounting hardware. No modification to the Sol is necessary. The printer can be restored to its original condition if required.

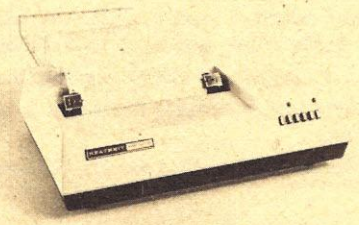
Hytype driver software is included on CUTS cassette along with a source listing. The user may modify the driver software to suit a particular application.

Suggested retail price for both the Hytype I and Hytype II is $150. Delivery is stock to 30 days.

For more information, see your Sol dealer or if more convenient, address Processor Technology Corporation, 7100 Johnson Industrial Drive, Pleasanton, CA 94566, (415) 829-2600.

Diablo and Hytype are TMs of the Xerox Corporation.

CIRCLE 228 ON READER SERVICE CARD



HEATH INTRODUCES NEW LOW-COST LINE PRINTER

Heath Company, Benton Harbor, Michigan has made available a factory assembled and tested low-cost line printer designed for use with its H8 and H11A computer systems (and others) using a standard serial interface. The WH-14 Line Printer prints standard 96-character ASCII set (upper and lower case) on a 5x7 dot matrix print head with a maximum instantaneous print speed of 135 characters per second. Line spacing is 6 lines per inch (8 lines per inch software-selectable) with selectable line length of 80, 96 or 132 characters. Baud rate is also selectable from 110-9600. The WH-14 uses 0.5" wide nylon inked ribbon on 2" spools. Ad-

justable width sprocket feed allows the use of edge-punched fan-fold paper forms from 2.5" to 9.5" wide having a maximum thickness of 0.006".

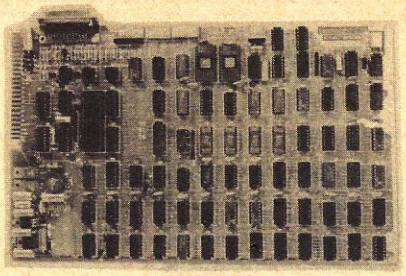
The WH-14 connects to the H8 or H11A computer via a standard RS-232C serial interface or 20mA current loop. Handshaking is provided by reverse data channel or busy control signal. A 25-pin male EIA connector is provided for hookup and a paper rack is included at no extra cost. A kit version (the H-14) of the WH-14 will be available in the near future.

For more information on the WH-14 Line Printer which is mail order priced at $895.00, (F.O.B. Benton Harbor, MI.) send for a FREE copy of the latest Heathkit Catalog. Write Heath Company, Department 350-820, Benton Harbor, Michigan 49022.

CIRCLE 229 ON READER SERVICE CARD

SINGLE BOARD TERMINAL

A new, Single Board 80x24 Terminal has been announced by Electrolabs POB 6721, Stanford, Ca. 94305. This concept in Standard Interface Terminals is the ESAT 200B and features user alterable EPROMS to contain Two Fonts of up to 128 characters each. The ESAT 200B also features split speed serial data transmission and reception, RS232C, 20mA loop and TTL interface levels and a Copyrighted Design with a Low Package Count compared to other terminal designs (only 85 IC's for the ESAT 200B versus 200+ IC's (!) for the ADM 3A). This leads directly to



lower price, greater reliability, less expensive maintenance procedures and smaller size.

The User Alterable Fonts are programmed into 256 7x8 cells which are displayed contiguously. This allows the rendition of Extended Characters in two or more adjacent cells (this capability is similar to that of the Megadata 700D/L). Electrolabs emphasizes the versatility and generality of this approach: anything may be programmed into these character cells including Middle Eastern alphabets, APL characters and limited graphics. If the user has no EPROM programmer, he may simply pencil in the spaces in a printed grid, return it and a check for $50 to Electrolabs. Electrolabs will send him a new EPROM 2708 programmed to display the contents of his character cells exactly as he has drawn them. $329.

Electrolabs, P.O. Box 6721, Stanford, CA 94305. (415) 321-5601.

CIRCLE 230 ON READER SERVICE CARD

VENDOR LITERATURE

64-PAGE MAIL ORDER CATALOG

S-100, Inc. has issued a big 64-page catalog of computers and peripherals mostly for the S-100 bus. Manufacturers listed include North Star, Vector Graphic, Cromemco, Centronics, D.C. Hayes, Ithaca Audio, Computalker, IMSAI, ECT, SD Systems, Teletype, Hazeltine, Dynabyte, Tarbell, SSM, and many others. Best of all, S-100, Inc. gives a 10% discount on all items and a further 5% for payment with your order. Our orders from S-100 have been promptly filled and we've found the owners, Phyllis and Bernie Frank, anxious to please. Catalog and separate price list are free.

S-100, Inc., 7 White Place, Clark, NJ 07066. (201) 382-1318.

CIRCLE 231 ON READER SERVICE CARD

WORK SHOPS

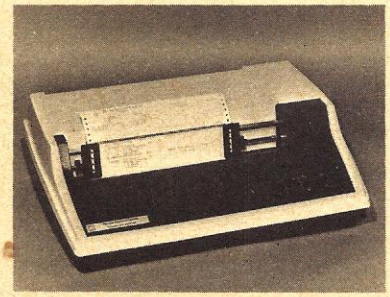
OF wood and metal workers, without steam power, equipped with

BARNES' FOOT POWER MACHINERY allow lower bids

on jobs and give greater profit on the work. Machines sent on trial if desired. Catalogue free.

W. F. & JOHN BARNES CO.,
200 Ruby Street, Rockford, Ill.

AVAILABLE NOW



$1695 T.I. 810 printer

- 150 cps bi-directional impact printer
- Tractor feed, 3" to 15", up to 6-part
- Programmable forms length
- EIA RS-232 serial, 110-9600 baud

Options:

- Upper/lower case $90—Stand & paperbasket $135
- Forms Length Control $90—Vertical Format Control $180
- FLC/Compressed Print $180—VFC/Compressed Print $270

SOROC IQ 120

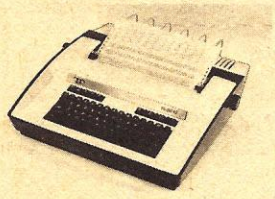
$795

- Upper/lower case, 24 X 80 12" display
- Numeric keypad, cursor control keys
- RS-232 interface plus extension port

Need more intelligence?

SOROC IQ 140 $1345

Need a Texas Instruments portable, ASR or KSR? Call MICROMAIL



Teletype 43 $999

- Upper/lower case, 132 columns
- RS 232 serial, 110 or 300 baud
- 12" X 8½" pin-feed paper

(1620 pictured)

Diablo 1641/3 $2910

- Letter-quality printing
- HyType II daisywheel printer
- RS 232 serial, 110-1200 baud

FROM MICROMAIL

To order: Send a certified check or money order. Personal or company checks require two weeks to clear.
Handling: Less than $2000, add 2%; over $2000, add 1%.
Tax: California residents add 6% sales tax.

All terminals shipped freight collect In original carton with manufacturer's warranty.

Write for free catalogue

MICROMAIL • BOX 3297 • SANTA ANA, CA 92703
(714) 731-4338

CIRCLE 172 ON READER SERVICE CARD

REALTY EXPENSE ANALYSIS PROGRAM
with
tax-ready totals for IRS filing

REAP is designed for the property owner or manager, providing complete expense information for each building in payment by payment or summary format including -

BUILDING-PAYEE report displays buildings expenses for all or a selected payee.

UTILITY-SUMMARY report displays yearly, year-to-date, or average monthly expense by building for electric, gas, water, trash

TAX-TOTALS report lists building totals for utilities, insurance, property tax, and repairs for each building.

Complete data input, edit, and sort capabilities with extensive error recovery make data maintainence easy. Each 16K of memory will handle 500 yearly expenses larger data files are possible with disk

REAP is available on cassette w/complete documentation for - TRS-80, Apple, PET

Introductory Price - $25.00

REALTY SOFTWARE CO., 2045 Manhattan Ave.
Hermosa Beach, CA., 90254

VISA/MC call 213 372-9419

CIRCLE 150 ON READER SERVICE CARD

® CATCH·A·PULSE II
LOGIC PROBE
10 Nsec SPEED AT
4 to 15V LEVELS

Compatible with DTL, TTL, CMOS, MOS, and Microprocessors using a 4 to 15V power supply. Thresholds automatically programmed. Automatic resetting memory. No adjustment required. Visual indication of logic levels, using LEDs to show high, low, bad level or open circuit logic and pulses. Highly sophisticated, shirt pocket portable (protective tip cap and removable coil cord). Eliminates need for heavy test equipment. A definite savings in time and money for engineer and technician.

Pat. Pend.

Dealer inquiries welcome

ONLY
$44.95

- 10 Nsec pulse response
- Open circuit detection
- Replaceable tip & cord
- High input impedance
- Pulse stretching
- Multi-family

SPECIAL PAK-II $51.95
Includes a standard coiled cord, coiled cord with micro hooks, adapter for using CATCH-A-PULSE on logic families whose power supply is 15V to 25V. Shipping add $2.00 per probe.

AM ELECTRONICS
Box 19299, San Diego CA 92119
(714) 447-1770

CIRCLE 126 ON READER SERVICE CARD

FLOPPY DISK & TAPE SYSTEMS

DUAL-FLOPPY DISK SYSTEM INTRODUCED

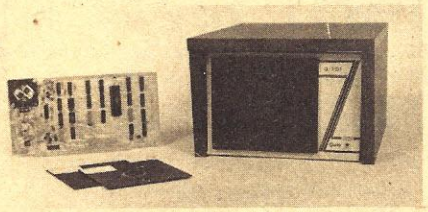
WESTLAKE VILLAGE, CA... A fully integrated, dual-floppy disk system designed specifically for microcomputer systems has been announced by Vector Graphic Inc. Dual-Stor™, as the new system is called, comes complete with controller and dual floppy disk drive in a cabinet that matches the Vector I mnicrocomputer.

The Vector Graphic Dual-Stor disk system has a storage capacity of 243K bytes per 8-inch diskette and utilizes the standard IBM compatible recording format.

Thoroughly tested and completely assembled, the Vector Graphic Dual-Stor comes complete with Disk Controller Board, DOS, Basic Compiler, Assembler, String-Oriented Editor, and Debug Software. Suggested retail price is $2300 each. The Dual-Stor is available at all authorized Vector Graphic dealers.

For more information contact Yvonne Beck, Vector Graphic Inc., 31364 Via Colinas, Westlake Village, CA 91361. (213) 991-2302.

CIRCLE 230 ON READER SERVICE CARD



QUAY 80 F1 — S100 FLOPPY DISC SYSTEM

A floppy disc system for use in S-100 bus computers is available from Quay Corp., P.O. Box 386, Freehold, N.J. 07728. The Quay 80 F1 system, priced at $795, includes the Q/80 FDC - floppy disc controller board (capable of supporting up to four discs), QDOS - disc based operating system, the Q/FD1 125 KB 5¼" band-driven disc drive with power regulator and interface cable, and the Q/80 FC - floppy disc cabinet. Add-on drives (Q/FD1) are priced at $395 each.

In addition to the floppy disc support, the Q/FDC has available a programmable 8-bit, TTL compatible, parallel I/O port capable of supporting standard peripheral devices such as line printers, tape punches, keyboards, etc. Product availability is 30-60 days ARO.

CIRCLE 233 ON READER SERVICE CARD

PERCOM SOFTWARE PATCH FOR SWTP 8K BASIC

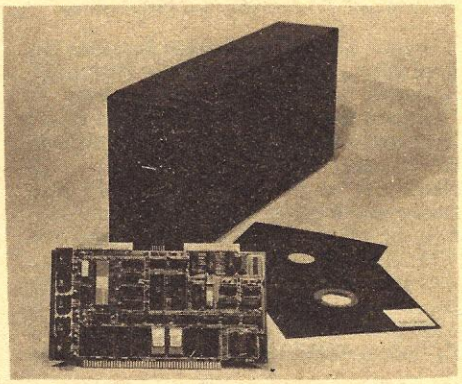
PerCom Data Company today announced availability of a software patch that adds disk data file commands and functions to Southwest Technical Products' 8K BASIC. SWTP 8K BASIC is for 6800-based machines.

With a disk storage system such as PerCom's LFD-400 minifloppy, and the augmented 8K BASIC in memory, a user has the full capability to create and maintain disk data files.

A listing of the patch program and user instruction manual sells for $10.00. The listing, manual and diskette recording of the patch and patch loader sells for $15.00.

These may be purchased from PerCom Data Company, 318 Barnes, Garland, TX 75042.

CIRCLE 234 ON READER SERVICE CARD



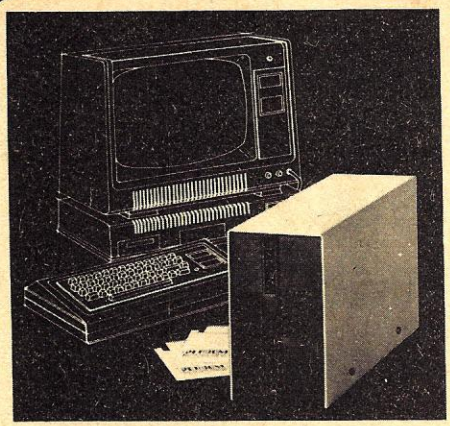
INFO 2000 OFFERS FASTER, LOWER COST FLOPPY DISK SYSTEM FOR ALL S-100 BUS MICROCOMPUTERS.

INFO 2000 Corporation has announced immediate availability of their new high-performance floppy disk system for S-100 bus microcomputers. The S-100 disk system combines the PerSci Model 277 dual diskette drives with the INFO 2000 DISCOMEM Controller Board and Digital Research CP/M to provide all necessary hardware and software, when added to any S-100 bus computer, for immediate operation. Two spindles accept standard soft-sectored 8" flexible diskettes. The system provides full compatibility with IBM 3740 format.

In addition to the disk controller, the DISCOMEM board contains input/output interfaces required for most microcomputer systems. These include 2 RS-232 serial interfaces with software selected baud rates from 50 to 19,200 bits per second, 3 8-bit TTL-level parallel interfaces (2 output, 1 input), and provision for 8K of EPROM or for 7K of EPROM and 1K of scratchpad RAM. The I/O facilities enable the DISCOMEM to be combined with just two additional S-100 logic boards—a CPU board and a 32K RAM board—to create a complete high-performance, disk-based microcomputer system for business or scientific applications. $2600.

INFO 2000 Corp., 20630 S. Leapwood Ave., Carson, CA 90746. (213) 532-1702.

CIRCLE 235 ON READER SERVICE CARD



PERCOM MANUFACTURING ADD-ON DISK DRIVES FOR TANDY RADIO SHACK TRS-80 COMPUTER

Harold Mauch, president of PerCom Data Company, announced here today that the company is now manufacturing "add-on" minifloppy disk drives for the Tandy Radio Shack TRS-80 computer.

The PerCom unit, which includes the drive, drive power supply, and enclosure, is identical in all important respects to the TRS-80 Mini-Disk System.

The PerCom unit sells for $399.00. The Radio Shack Mini-Disk System lists at $499.00.

The drive itself is the proven Shugart SA-400 — the same drive used in the Radio Shack unit. The data transfer rate is 125 kilo-bits per second.

Interfacing of disk drives to the TRS-80 computer is accomplished with the Radio Shack TRS-80 Expansion Interface, which accommodates up to four drives (and other peripherals), and includes controller electronics and a four-drive cable. Operating software for all drives is obtained by the user with the purchase of the first drive from Radio Shack.

For more information, please contact the PerCom Data Company, 318 Barnes, Garland TX 75042, (214) 272-3421.

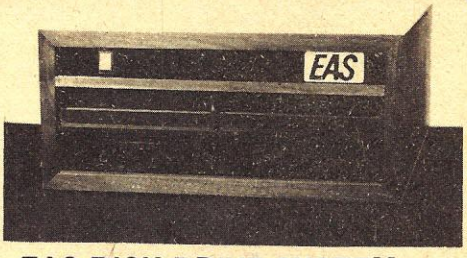
CIRCLE 236 ON READER SERVICE CARD

CARTRIDGE DISK

IMSAI has announced the availability of a large capacity double density cartridge disk drive. The unit is actually the 9427H drive manufactured by Control Data. The unit features direct head addressing to the desired track which yields a 35 ms average access time. Capacity is 50 x 10^6 bits on each removable cartridge disk pack. Projected price $9995. (Complete information was not available at presstime, however, use the reader service card to get more).

IMSAI, 14860 Wicks Blvd., San Leandro, CA 94557. (415) 483-2093.

CIRCLE 237 ON READER SERVICE CARD



EAS DISK DRIVE SYSTEM

The EAS disk system is sold fully assembled and tested, consisting of two full-size, 8″ Shugart drives, Tarbell controller, which is capable of handling up to four drives and uses the 1771B controller chip and on board prom boot strap loader for CP/M™, as well as power supply, interface, all cables, cooling fan, strong aluminum chassis and attractive wooden cabinet.

The DOS S(disk operating system) software recommended and available separately from EAS is Digital Research's CP/M™ assembler, text editor and debugger, with EAS I/O handlers (BIOS) together with powerful utilities, one of which is capable of formatting diskettes.

The EAS DISK DRIVE SYSTEM is S-100, Z-80, 8080 and IBM compatible, and can be purchased with or without controller. Electro Analytic Systems, Inc. offers a 90-day parts and workmanship warranty and dealer inquiries are invited. $1995.

CIRCLE 238 ON READER SERVICE CARD

TERMINALS FROM TRANSNET

PURCHASE
12-24 MONTH FULL OWNERSHIP PLAN
36 MONTH LEASE PLAN

DESCRIPTION	PURCHASE PRICE	PER MONTH 12 MOS.	24 MOS.	36 MOS.
DECwriter II	$1,495	$145	$ 75	$ 52
DECwriter III, KSR	2,695	257	137	95
DECwriter III, RO	2,095	200	107	73
DECprinter I	1,795	172	92	63
VT100 CRT DECscope	1,595	153	81	56
TI 745 Portable	1,875	175	94	65
TI 765 Bubble Mem.	2,995	285	152	99
TI 810 RO Printer	1,895	181	97	66
TI 820 KSR Terminal	2,395	229	122	84
QUME, Ltr. Qual. KSR	3,195	306	163	112
QUME, Ltr. Qual. RO	2,795	268	143	98
ADM 3A CRT	875	84	45	30
HAZELTINE 1400 CRT	845	81	43	30
HAZELTINE 1500 CRT	1,195	115	67	42
HAZELTINE 1520 CRT	1,595	153	81	56
DataProducts 2230	7,900	725	395	275
DATAMATE Mini floppy	1,750	167	89	61

FULL OWNERSHIP AFTER 12 OR 24 MONTHS
10% PURCHASE OPTION AFTER 36 MONTHS

ACCESSORIES AND PERIPHERAL EQUIPMENT
ACOUSTIC COUPLERS • MODEMS • THERMAL PAPER RIBBONS • INTERFACE MODULES • FLOPPY DISK UNITS

PROMPT DELIVERY • EFFICIENT SERVICE

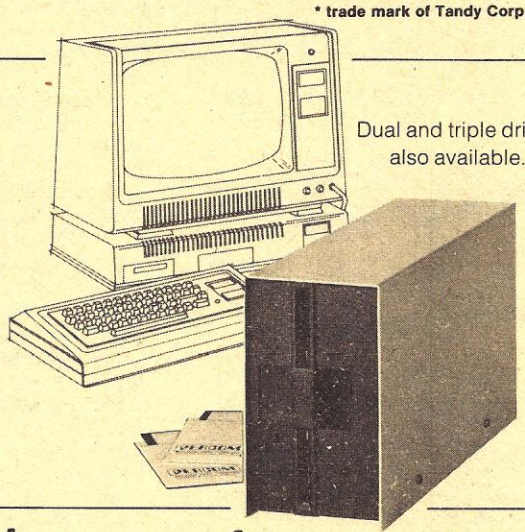
TRANSNET CORPORATION
2005 ROUTE 22, UNION, N.J. 07083
201-688-7800

CIRCLE 158 ON FREE INFORMATION CARD

NOW...

Add-on Mini-Disc for the TRS-80*

* trade mark of Tandy Corp.



Dual and triple drives also available.

only $399.00

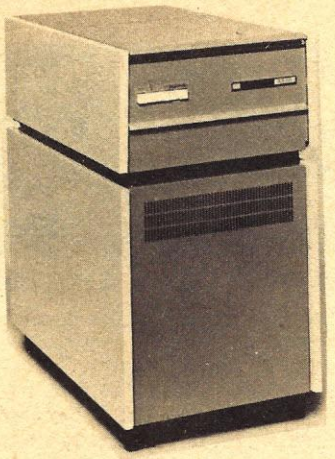
Requires 16K RAM, Level II BASIC and Expansion Interface.

from PERCOM

PERCOM DATA COMPANY, INC.
DEPT. C • 318 BARNES • GARLAND, TEXAS 75042
Phone: (214) 272-3421 or
Call toll free: 1-800-527-1592

*RADIO SHACK and TRS-80 are trademarks of Tandy Corporation which has no relationship to PERCOM DATA COMPANY, INC.

CIRCLE 155 ON READER SERVICE CARD



ALPHA MICRO ADDS S-100 BUS COMPATIBLE 10- MEGABYTE DISK SUBSYSTEM

Alpha Micro, one of the industry's leading manufacturers of microcomputers and computer products, has announced the addition of the model AM-500, an S-100 bus compatible 10-megabyte disk system to its expanding product line.

The AM-500 is a compatible subsystem and consists of a single board controller, interconnect cable, and disk drive. The disk drive is the popular 10-megabyte Control Data Corporation "Hawk," which utilizes a 5-megabyte fixed disk and 5-megabyte removable cartridge. The controller board is interrupt driven, requires a very simple interface to the CPU operating system, and does complete 512-byte transfers.

The AMOS disk operating system provides the microcomputer user with the sophisticated software of a minicomputer; it permits multiple user, multiple tasking, time sharing, and memory management. And, up to four (4) drives can be daisy-chained to one controller. The AM-500 is available through a network of retail dealers. $7,995. Alpha Micro, 17881 Sky Park North, Irvine, CA 92714; (714) 957-1404.

CIRCLE 239 ON READER SERVICE CARD

DUAL CALCOMP FLOPPY DISK SYSTEM FROM IMSAI

IMSAI MANUFACTURING CORPORATION now offers the PCS-80/21, 22 Floppy Disk System featuring CalComp Model 142M disk drives. System configurations are based on either IMSAI's DIO-C Controller or FIF Controller. Up to four drives are supported by either controller. The DIO-C Controller will provide over 2.4 megabytes of on-line storage.

IMSAI is the first microcomputer manufacturer with an interface that supports four different formats, including the new IBM formats for double density. These formats can be selected under software control. The interface can change dynamically between single and double density as required by the new IBM formats.

The DIO-C Controller is compatible with all IMSAI 8080/8085-based microcomputers. In double density, disk storage capacity is up to 625K bytes per drive. IMSAI's Multi-Disk Operating System Version 2.05 and newer supports the DIO-C Controller.

The FIF Controller is compatible with IMSAI's I-8080 microcomputer. Using the FIF Controller, CalComp disk drives use an IBM 3740-compatible, single density format. Disk storage capacity is 256K bytes per drive. The FIF moves data between the system's microprocessing unit and the peripherals via a Direct Memory Access channel (DMA). IMSAI MANUFACTURING CORPORATION, 14860 Wicks Boulevard, San Leandro, California 94577, (415) 483-2093.

CIRCLE 240 ON READER SERVICE CARD

FAMILY OF 8-INCH FLOPPY DISK SYSTEMS FOR M6800-BASED COMPUTERS

Smoke Signal Broadcasting, manufacturers of M6800 microprocessor-based computer peripherals for the hobby and personal computing market, announced the addition of a family of 8-inch floppy disk drive systems to its growing product line.

The new family consists of three systems: the Model LFD-1, single drive, single side, single density system; the Model LFD-2, dual drive, single side, single density system, both using the reliable Shugart SA-800 drive. Rounding out the family is the Model DFD-2, a dual drive, double sided, single density system based on the Shugart SA-850 drive. The Shugart drives were selected because of their outstanding quality control and field-proven reliability.

An extremely desirable feature of the new drive system is the total compatibility of the disk operating system (DOS-68) and the Disk File Basic (DFB-68) with existing Smoke Signal Broadcasting software. No software changes are required.

The systems are priced as follows: LFD-1 = $1395, LFD-2 = $1895, and DFD-2 = $2495. All systems are available in less than 30 days.

For more information, call or write to Ed Martin, Smoke Signal Broadcasting, 6304 Yucca Street, Hollywood, CA 90028. (213) 462-5652.

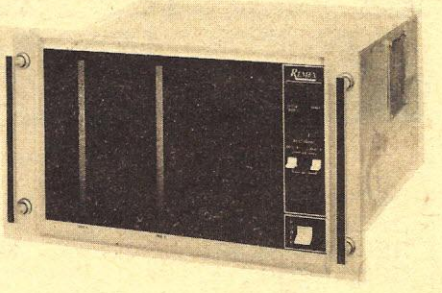
CIRCLE 241 ON READER SERVICE CARD

BETA-1 HIGH SPEED, LOW COST TAPE STORAGE

A universal tape storage device that interfaces to most popular microcomputers, including non-S100 bus systems, has been announced by MECA, manufacturers of Alpha-1 and Delta-1 mass storage systems. Called BETA-1, this unit plugs directly into a standard 8-bit parallel port. Serial port connection is offered as an option. The high speed digital tape transport features random seek at more than 100 inches per second, with average access times in 10 seconds or less, and loading time at 8,000 bits per second. An option is available to permit loading speed of 16,000 bits per second.

Employing the industry-standard phase-encoding technique, the BETA-1 is reported to be highly reliable. An internal 8035 microprocessor with a 1K byte program and high level tape operating system assure easy-to-use operation. $399. MECA, 7026 O.W.S. Road, Yucca Valley, CA 92284. Telephone (714) 365-7686.

CIRCLE 242 ON READER SERVICE CARD

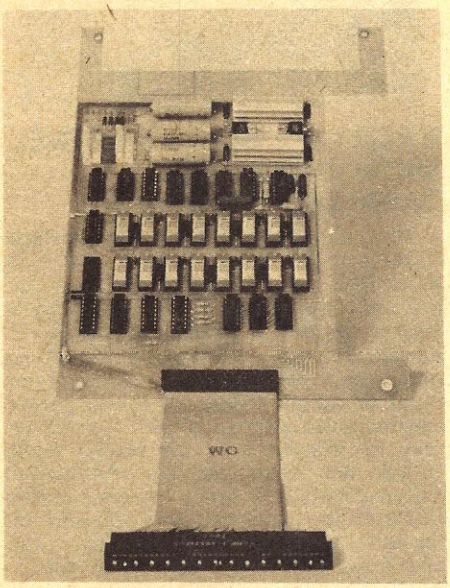


PLUG COMPATIBLE DISKETTE SYSTEMS FOR PDP-11 AND LSI-11 USERS

The Remex 11/11 and 11/12 are PDP-11 and LSI-11 plug-compatible systems which incorporate two Remex flexible disk drives with built-in formatters, interface and diagnostics. All elements are transparent to the customer's DEC RT-11 operating system. Like all Remex-11 systems, the new models are available with a special Remex RT-11 utility module called Translate-11 that allows data interchange between the Remex RT-11 system supported devices and an IBM 3740. The module performs the necessary translations and uses all standard Remex RT-11 file management services. $3195. Remex, 1733 Alton St., Irvine, CA 92713.

CIRCLE 243 ON READER SERVICE CARD

MEMORY



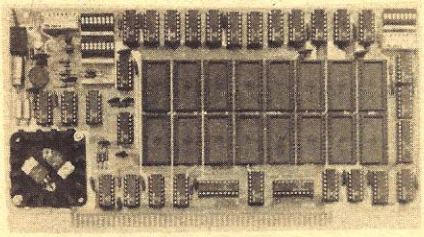
PME-1 MEMORY BOARD EXPANDS MEMORY OF COMMODORE PET

Computer Mart Systems of New York is offering the PME-1 Memory Board in three configurations, designed to add 16, 24, or 32 kilobytes of memory to the Commodore PET computer. The PME-1 comes complete with all necessary hardware, and requires no electrical modification of the PET. The memory board derives its power from the PET transformer (but not from the PET regulators).

The cost of the PME-1 board has been reduced to $500 for the 16K board, $595 for the 24K, and $675 for the 32K. The board is covered by a six-month parts and labor warranty.

Computer Mart Systems, 13 East 30th Street, New York NY 10016.

CIRCLE 244 ON READER SERVICE CARD



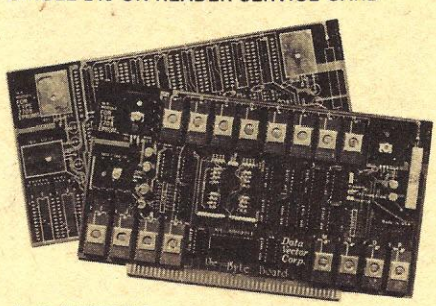
32K BYTESAVER MEMORY BOARD WITH 2716 PROM PROGRAMMER

Cromemco's 32K BYTESAVER® card provides an on-board 2716 PROM programmer. Information can be stored quickly and permanently by a simple, one-time write of the desired data into an erased PROM with the on-board programmer turned on. The card also provides a full 32 kilobyte capacity of non-volatile storage for ROM-intensive applications.

The 32K BYTESAVER holds up to 16 of the Intel 2716 PROMs or equivalent. Switches are provided to: (1) protect and un-protect PROMs individually or in groups for programming, (2) shadow ROM socket pairs (which allows external RAM to overlap portions of ROM address space), (3) select card address, (4) control the powerful Bank-Select and DMA IN-OUT features. $195 kit, $295 assembled.

Cromemco, Inc., 280 Bernardo Ave., Mountain View, CA 94040, (415) 964-7400.

CIRCLE 245 ON READER SERVICE CARD



A BETTER EPROM MODULE

Data Vector Corporation has announced the Byte Board, a better EPROM module for the S-100 bus. The unit accepts up to sixteen 2708 EPROMs, incorporates a Power-On Jump capability and provides for wait state generation for slow memories.

Each EPROM is individually addressable on any 1K boundary, and may be placed anywhere in the computer's address

You can use the versatile new BETSI to plug the more than 150 S-100 bus expansion boards directly into your PET*!

On a single PC card, BETSI has both interface circuitry and a 4-slot S-100 motherboard. With BETSI, you can instantly use the better than 150 boards developed for the S-100 bus. For expanding your PET's memory and I/O, BETSI gives you the interface. The single board has both the complete interface circuitry required and a 4-slot S-100 motherboard, plus an 80-pin PET connector. BETSI connects to any S-100 type power supply and plugs directly into the memory expansion connector on the side of your PET's case. And that's it. You need no additional cables, interfaces or backplanes. You don't have to modify your PET in any way, and BETSI doesn't interfere with PET's IEEE or parallel ports. And—when you want to move your system—BETSI instantly detaches from your PET.

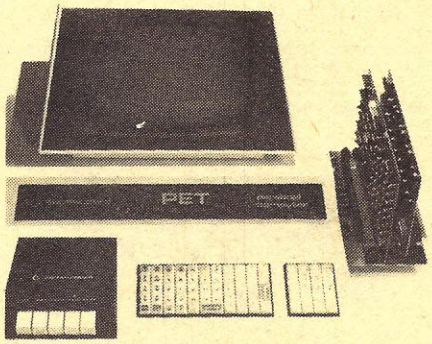
BETSI is compatible with virtually all of the S-100 boards on the market, including memory and I/O boards. BETSI has an on-board controller that allows the use of the high-density low-power "Expandoram" dynamic memory board from S.D. Sales. This means you can expand your PET to its full 32K limit on a single S-100 card! Plus, you won't reduce PET's speed when you use either dynamic or static RAM expansion with BETSI. Additionally, BETSI has four on-board sockets and decoding circuitry for up to 8K of 2716-type PROM expansion (to make use of future PET software available on PROM). BETSI jumpers will address the PROMs anywhere within your PET's ROM area, too.

MAIL ORDERS ARE NORMALLY SHIPPED WITHIN 48 HOURS. VISA AND MASTER-CHARGE ORDERS ARE BOTH ACCEPTED.

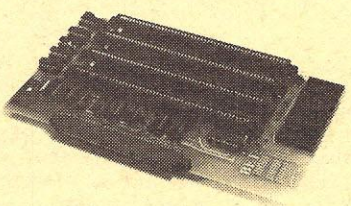
The BETSI Interface/Motherboard Kit includes all components, a 100-pin connector, and complete assembly and operating instructions for $119.

The Assembled BETSI board has four 100-pin connectors, complete operating instructions and a full 6-month Warranty for just $165.

FORETHOUGHT PRODUCTS
87070 Dukhobar Rd. #P
Eugene, Oregon 97402
Phone (503) 485-8575



BETSI is the new Interface/Motherboard from Forethought Products—the makers of KIMSI™—which allows users of Commodore's PET Personal Computer to instantly work with the scores of memory and I/O boards developed for the S-100 (Imsai/Altair type) bus. BETSI is available from stock on a single 5½" x 10" printed circuit card.



BETSI is available off-the-shelf from your local dealer or (if they're out) directly from the manufacturer.

Ask about our memory prices, too!

© 1978 Forethought Products

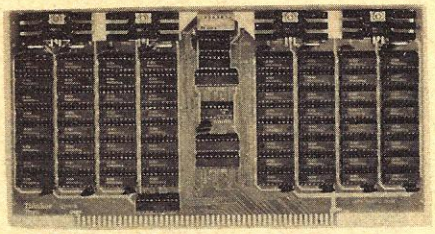
*PET is a Commodore product.

space, irrespective of where any of the other EPROMs are placed, and unused EPROM locations do not take up memory address space.

The Byte Board, without EPROMs, may be purchased assembled and tested for $99 or in kit form for $69. Fully loaded with 16 EPROMs, the module is $243 assembled or $213 in kit form. EPROMs available separately.

Data Vector Corporation, P.O. Box 3141, Burbank, CA 91504.

CIRCLE 246 ON READER SERVICE CARD



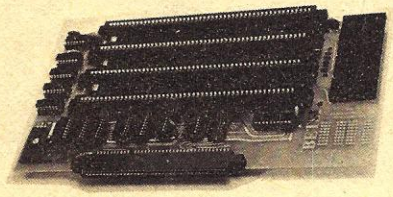
SUPERRAM

The SuperRam™ 32K static RAM board is the latest in the line of S-100 memories designed by George Morrow. It uses the National 5257 or the TI equivalent 4044 4Kx1 NMOS memory chips and can be run at 2 MHz for standard 8080 systems or 4 MHz for Z-80 systems. A phantom option has been provided for CPUs using this line. All control signals, addresses and data lines are fully buffered. Each 16K block is independently addressable and write protected. This board contains only seven support ICs and the typical power consumption is 2.6 amps. $649 kit; $699 assembled.

Thinker Toys, 1201 10th St., Berkeley, CA 94710. (415) 524-2101.

CIRCLE 247 ON READER SERVICE CARD

PERIPHERALS



QUALITY S-100 EXPANSION FOR COMMODORE'S PET COMPUTER

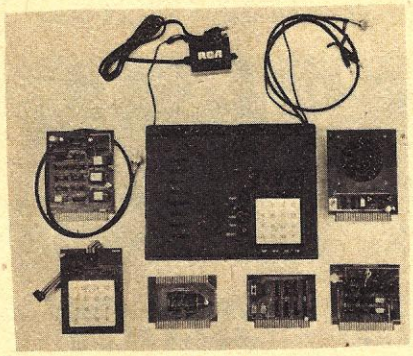
Forethought Products (known for their "Kimsi" KIM to S-100 expander) has made official announcement of their PET to S-100 Interface/Motherboard "Betsi." Betsi (renamed from "Petsi" after action by Commodore Inc.) is a single circuit board that contains all the necessary logic to interface S-100 type boards to the PET.

Unlike other interfaces which require the addition of external chassis, S-100 backplanes, or special cable assemblies, Betsi attaches directly to PET's memory expansion connector and provides both interface logic AND four S-100 slots on a single compact circuit board. Betsi operates with any S-100 power supply and doesn't interfere with use of PET's parallel or IEEE ports.

In addition to its compatibility with most available S-100 boards, Betsi boasts a breakthrough with its on-board DYNAMIC MEMORY CONTROLLER. This controller, which allows PET/Betsi to use the S.D. Sales "Expandoram" memory board, means that PET's memory can be expanded to the limit (32K) with a single S-100 card! Kit — $119; assembled — $165.

Forethought Products; PO Box 8066; Coburg, OR 97401. (503) 485-8575.

CIRCLE 248 ON READER SERVICE CARD

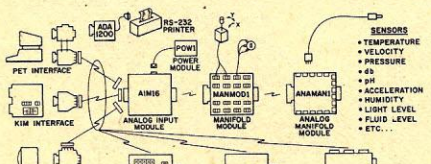


RCA VIP PERSONAL COMPUTER ADD-ONS

RCA is offering a variety of options which permit the user of an RCA VIP hobby computer to expand his system's capabilities. Shown grouped counterclockwise around the VIP console are, from top left: a color expansion board permitting video displays in up to eight colors, an expansion keyboard to permit interactive play by two game competitors, the expansion keyboard interface card, a memory expansion board capable of holding 4K of RAM, the Super Sound Board which permits a four-octave music range, and the Simple Sound Board which is a simplified version of Super Sound.

RCA COSMAC VIP Marketing, New Holland Ave., Lancaster, PA 17604.

CIRCLE 249 ON READER SERVICE CARD

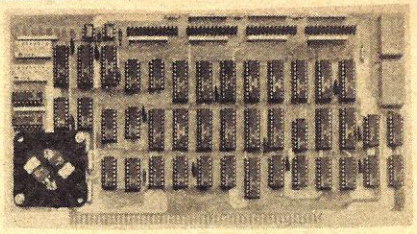


AIM16

The AIM16 is the Analog Input Module of the CmC DAM (Data Acquisition Modules) SYSTEMS. The AIM16 has 16 8-bit analog inputs. Each input is individually addressed. Conversion time is 100 microseconds. The AIM16 can be used with any computer that has an 8-bit output port and an 8-bit input port. The AIM16 sells for $159.00. The AIM16 starter kit (AIM16, power supply, and input and output connectors) sells for $189.00. All DAM SYSTEMS products are assembled and tested units.

Connecticut microComputer, 150 Pocono Road, Brookfield, Connecticut 06804, (203) 775-9659.

CIRCLE 250 ON READER SERVICE CARD

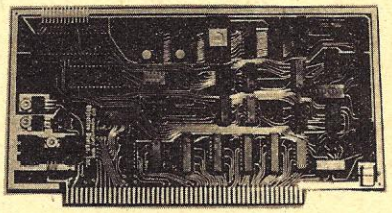


8 PORT I/O MULTI-CHANNEL MICROCOMPUTER PARALLEL INTERFACE

The Cromemco 8PI/O Parallel Interface Card provides 8 bidirectional 8-bit I/O ports that can be used either singly or coupled together to form longer word lengths. Input and output status flags for handshake purposes are grouped together on one port and may be accessed with one input or output statement. Strobe pulses can be issued after each 8-bit transfer or may be delayed until the proper word length has been formed. Additional features include 8 sense switches and 8 LEDs on the highest selected I/O port on the card, and 2 bits of opto-isolated input and 2 bits of relay-driven output. Kit — $195; assembled — $295.

Cromemco, Inc., 280 Bernardo Avenue, Mountain View, CA 94040; (415) 964-7400.

CIRCLE 152 ON READER SERVICE CARD



S-100 BOARD IS KEY TO TURNKEY AND BLACKBOX COMPUTER OPERATIONS

The SYSCON (for System Controller), a new S-100 card by Objective Design, Inc. is designed to complement the CPU in sophisticated systems. The board provides for PROM (to 6K of TMS 2716s), 256 bytes of scratchpad RAM, true CALL type interrupts, power-on jump, Real Time Clock, on-board generation of MWRITE, and an 8 bit parallel output port. Kit — 207.95.

Objective Design, Inc., P.O. Box 20325, Tallahassee, FL 32304, (904) 224-5545.

CIRCLE 153 ON READER SERVICE CARD

CALL ME TUESDAY AT 4

A unique combination of crystal derived Real Time Clock, hardware interrupts, and PROM software come together in the TIMEMINDER — an S-100 compatible board by Objective Design. TIMEMINDER software will maintain a list of user requested wakeup calls and alert the indicated routines at appointed times. Intervals range from milliseconds to days. User calls can also be based on the TIMEMINDER time-of-year calendar. Wake-up requests are then given as time and date. Because this is an interrupt driven device, the computer is always available for non-timed activities while

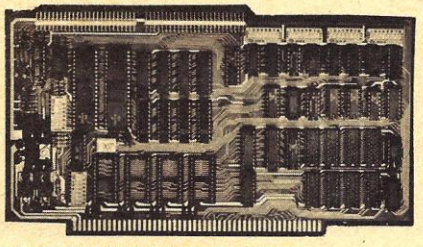
waiting for the next alarm. Timed interrupts may also be applied to control of time-critical hardware and software — a valuable tool for scientists and experimenters.

TIMEMINDER software is held in on-board PROM, with scratchpad RAM also available on the card. The interrupts and the required 'CALL' instruction vectors are all generated on-board. Additional interrupts are free for general system use.

TIMEMINDER kit including PROM is $224.95 plus $5.00 shipping.

Objective Design, Inc., P.O. Box 20325, Tallahassee, FL 32304 (904) 224-5545.

CIRCLE 156 ON READER SERVICE CARD



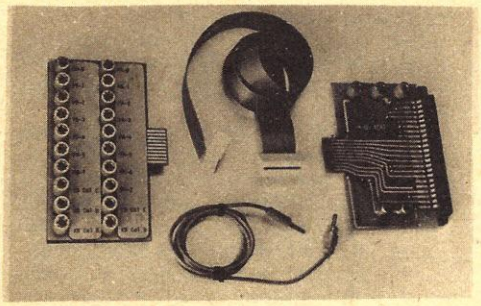
THE SWITCHBOARD

Thinker Toys announces its latest design innovation by George Morrow — the SWITCHBOARD™, an I/O board for S-100 systems. It has four parallel ports and two RS232/TTY serial ports plus strobe and attention ports. In addition, there are options for 4K of RAM and 4K of EROM.

Every port is switch programmable for flexibility in interfacing various types of peripherals. Each parallel port can be switched for input or latched output. Both serial ports can be switched to any of sixteen baud rates from 110 to 19K. Each strobe and attention port flip-flop can be switched for positive or negative pulsing. The eight I/O addresses of the SWITCHBOARD can be located on any boundary divisible by eight. Price is $199.00 kit and $259.00 assembled retail.

Thinker Toys, 1201 10th St., Berkeley, CA 94710 (415) 524-2101.

CIRCLE 157 ON READER SERVICE CARD

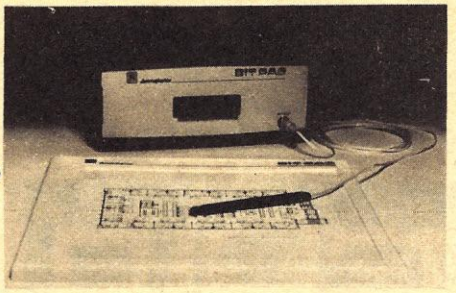


KIM ADAPTORS FOR EXPERIMENTERS

The Technical Education Research Centers (TERC) of Cambridge, MA have developed two adaptors to the KIM-1 microcomputer for experimenters who need to breadboard special input/output applications. Called the KIM-1 Interface Sets, these make 20 I/O lines from the KIM available to either TERC's Modular Breadboarding System (illustrated) or to standard terminal strip breadboards. The adaptor connects directly to the KIM applications connector and also provides convenient power, tape recorder and TTY connections. $60.

TERC Services, 575 Technology Square, Cambridge, MA 02139. Telephone (617) 547-3890.

CIRCLE 162 ON READER SERVICE CARD



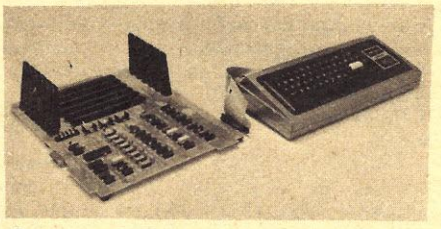
BIT PAD FOR TRS-80

Summagraphics Corporation announces the availability of an interface for the company's popular low cost digitizer, the Bit Pad, to the Radio Shack TRS-80 Microcomputer. This new interface permits the entry and transfer of X-Y coordinate values for graphics and data entry applications from the Bit Pad to the TRS-80 personal and home computer.

The interface is priced at $175 and includes a cassette enabling the user easy loading of the operating program to permit transfer of data. Data is transferred from the Bit Pad as five 8-bit bytes. The interface is contained in a small separate box that readily connects to both the Bit Pad and the TRS-80. The interface allows use of all other TRS-80 accessories. This new product adds to the Bit Pad the capability of interfacing to one of the most popular microcomputers. Also available from Summagraphics are interfaces to other Microcomputers.

Summagraphics Corp., 35 Brentwood Ave., Fairfield, CT 06430. (203) 384-1344.

CIRCLE 165 ON READER SERVICE CARD



S-100 + TRS-80

HUH Electronics announces the 8100, an S-100 Bus Adapter/Motherboard for the TRS-80. The 8100 allows a Radio Shack TRS-80 Computer to be interfaced to the popular S-100 Bus for memory expansion and extended I/O capabilities. The 8100 has its own built-in 6 slot motherboard which includes card guides which keep the boards in their places. The 8100 sits on a table top next to your TRS-80 and connects to it via a ribbon cable. A second TRS-80 connector allows other TRS-80 devices to be connected at the same time.

The 8100 also does much more. For example, the 8100 has optional on-board support circuitry and sockets for 16K of dynamic RAM. The RAM may be split into 4K blocks which can be addressed to any 4K boundary. 4K dynamic RAMs can be used instead of 16Ks for those left over from memory expansion of your CPU/Keyboard.

The 8100 also has optional I/O interfaces built on-board for both serial and parallel I/O. The serial interface provides RS232 or 20ma current loop with software programmable baud rate, modem control lines, word length, stop bits, etc. to an on-board DB-25 connector. Jumper selection allows the TRS-80 to look like a computer for driving printers etc., or a terminal for talking to larger computers or modems. You can even LPRINT or LLIST from Level II Basic. Lowest configuration — $185.

HUH Electronics, 1429 Maple St., San Mateo, CA 94402, (415) 573-7359, or your local computer dealer.

CIRCLE 181 ON READER SERVICE CARD

"UNIVERSAL" INTERFACE FOR COMMODORE PETS

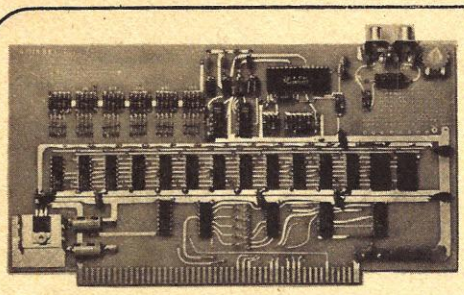
The RS-16-HP plugs into the Commodore PET's parallel I/O port and can be used for a wide variety of control applications. Using the PET's BASIC interpreter, or programming directly in 6502 assembly language, or even from the PET's interactive console, commands can be given to the RS-16 causing it to drive any one of sixteen output devices or to sense the condition of 16 to 14 input devices.

Output devices can be any 6 volt or less ON/OFF mechanism using less than ¼ Ampere. For example, lamps, LEDs, solenoids, and d.c. motors are typically used. Erector set motors and Meccano gears sets are popular electromechanical devices for computer control hobbyists. Relay coils can be driven directly; by selecting a 6 volt relay with appropriate contacts, the hobbyist can use the PET to control most appliances with manual switches, for example, R/C car handsets, model train switch boxes, stereos, garage door openers, etc.

Input devices can include TTL gates, or any form of switch contacts, including thermostats, reed switches (as in burglar alarms and train detectors), microswitches (detecting closed doors), joysticks, keyswitches and numeric keypads. Each of these hooks directly to the RS-16, and the PET can read the switch for open or closed condition. Up to eight of these switches can be wired for very fast operation; a switch closure can be "captured" and held until the PET recognizes it and then releases the stored data. $229.

Cooper Computing, Box 16082, Clayton, Missouri 63105.

CIRCLE 183 ON READER SERVICE CARD



SOUND EFFECTS AND MUSIC BOARD

Bootstrap Enterprises of Richardson, Texas has announced a new sound effects board compatible with S-100 computers. The μSOUNDER (MICROSOUNDER) can be programmed in BASIC or assembly language. One to five lines of code generates such sounds as organ music, sirens, phasers, shot guns, explosions, trains, bird calls, helicopters, race cars, airplanes, machine guns, barking dogs and many thousand more.

Now you can hear the sounds of phasers and photon torpedos in Star Trek. Listen to the roar of race cars followed by an occasional crash, practice Morse code recognition, create your own unique sounds and melodies or use the unit as a signaling device. Only a few minutes of time is needed to patch the sound code into existing programs.

Bootstrap Enterprises Inc., 100 N. Central Expressway, Richardson, Texas 75080.

CIRCLE 184 ON READER SERVICE CARD

MAGAZINES, JOURNALS

NEW MAGAZINE: TRS-80 COMPUTING

Radio Shack TRS-80 computer users can have both Level I and II Basics in the same machine, can have lowercase, can reduce the maze of cords, and can get some of the information about how to do these things free.

The second edition of the free Computer Information Exchange Newsletter tells how to shoehorn both Level I and II onto the same circuit board. It is available by sending SASE (with 15¢ postage) to CIE, box 158, San Luis Rey, CA 92068.

The lowercase articles, including what to do about the Radio Shack Level II blooper, are in CIE's magazine, TRS-80 Computing 1:1, subscriptions available for $10 (12 issues).

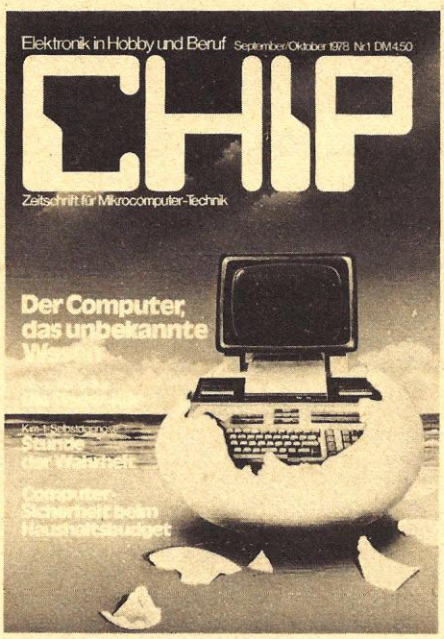
CIRCLE 185 ON READER SERVICE CARD

NEWSLETTER FOR RCA VIP OWNERS: VIPER

Subscription orders are now being accepted for the independent User Newsletter dedicated to the RCA COSMAC VIP. The $15.00 subscription price includes all ten issues of volume 1 - and issues #1 through #3 are currently available. The VIPER will include items of interest solely to owners of the VIP, and the first three issues contain articles revealing the machine language code for CHIP-8, the VIP's user language; an annotated listing of the operating system, and the first in a series of articles describing a text editor for the VIP.

Send subscription orders, articles, letters, software (for review, exchange, or sale) to THE VIPER, P.O. BOX 43, AUDUBON, PA, 19407. BAC/VISA/MC/check/money orders accepted. Sorry, no C.O.D. or billing. Overseas orders include $10.00 for airmail postage if desired.

CIRCLE 187 ON READER SERVICE CARD


Elektronik in Hobby und Beruf September/Oktober 1978 Nr.1 DM 4.50
CHIP
Zeitschrift für Mikrocomputer-Technik
Der Computer, das unbekannte

NEW ON THE GERMAN MARKET

Vogel-Verlag Wurzburg announces the publication of the first popular-technical special magazine for microcomputer techniques, the CHIP Magazine for Microcomputers with emphasis on self-assembly, programming and application — professionally and as a hobby — Start-off circulation 75,000.

Published (provisionally) every second month.

Available at book stalls, on railway stations, in special-line electronics and computer retail shops and, of course, as paid subscriptions (six issues for DM 24.00). Postfach 6740, D-8700 Wurzburg 1, Germany.

CIRCLE 188 ON READER SERVICE CARD

SOFTWARE

REFERENCE LIST OF COMPUTER CASSETTES

Remember Robert Elliott Purser's great lists of S-100 bus computers and peripherals? Well, he's at it again. This time he's put together a list of software cassettes for the PET, TRS-80 and Apple II. We don't know how many programs are listed, but there are more than we've ever seen in one spot. Programs and price are listed by name under the name of the company or individual selling it. Purser does not evaluate any of the programs; however, he does show some photos of the screen from a random assortment of programs in the center section of the booklet.

The November 1978 Reference list costs $2.00, while Edition 5, February 1979 (which we did not see) will cost $4.00 postpaid. Subscription price is $12.00 per year.

Robert Elliott Purser, P.O. Box 466, El Dorado, CA 95623.

CIRCLE 189 ON READER SERVICE CARD

ELECTRONIC TYPING NOW OFFERED FOR SOL SYSTEM III SMALL COMPUTER SYSTEM

A high performance electronic typing system which consists of a Sol System III-A, their new WordWizard software package and the new SolPrinter has been announced by Processor Technology.

Price for the new system is under $10,000. Delivery through selected Sol computer dealers throughout the United States and Canada is stock to 30 days.

Software for the package was developed by Basic Computer Group Ltd. of Vancouver, B.C., who have already installed the total package at a number of British Columbia legal, accounting, engineering, insurance, publishing, and other kinds of business firms.

Hardware for the system consists of the Sol computer mainframe with built-in keyboard, a 750,000 byte Helios II Disk Memory, a video monitor and a high speed bidirectional daisywheel printer.

The WordWizard Software lets the operator edit one document on the screen while the printer puts out another at high speed.

Text can be typed in at high speed since carriage returns are added by software. Automatic justification creates an even right margin, or the text can be left ragged right. Since all formatting is done on the screen, lines of text will be printed exactly as they appear. Several modes of cursor control and scrolling allow rapid access to any position of the document. Any amount of text already stored in the system can be called up almost instantly and inserted anywhere in the document under preparation.

For more information, see your local Processor Technology Dealer. Dial Toll Free (800) 227-1241 for his location. (In California, dial 800-972-5951). Or write Processor Technology Corporation, 7100 Johnson Drive, Pleasanton, CA 94566.

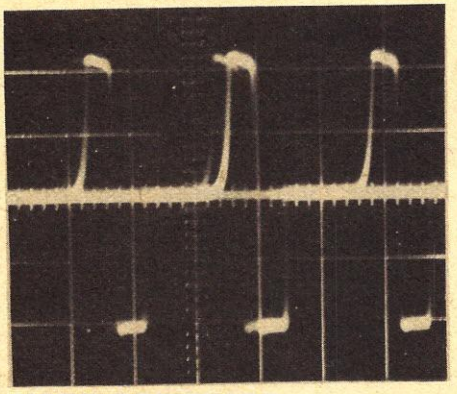
CIRCLE 190 ON READER SERVICE CARD

THE SOFTWARE EXCHANGE

The Software Exchange is a new publication devoted to the exchange of ready to use software for business and the home. Each issue of The Software Exchange has reviews and articles about microcomputer software.

The Software Exchange is a bimonthly magazine available at computer stores for $1 per issue, and by subscription for $5 per year (six issues). For air mail service to Canada or Mexico, add $4. Subscriptions to other foreign countries are $19 (air mail service). Inquiries and subscriptions may be sent to: The Software Exchange, Box 55056, Valencia, CA 91355

CIRCLE 192 ON READER SERVICE CARD



HARD SOFTWARE DUPLICATION

As a service for software publishers, Cook Labs (first stereo records 1952) has designed and is operating a complete new hi-speed system for economical digital cassette duplication. The source tape waveform is reconstituted for record heads, squared in triggers to match the waveform of the original computer output port. No recording bias is used, and the d-c based record circuitry handles all formats, including non-NRZ. Yields are very high, and premium tape (Agfa High Density) is used for product. Cook says that for software circulation the major problems have come from using ordinary audio tape, and analog (audio oriented) duplicators. The picture displays actual record head input for Level II, TRS, a format somewhat sensitive to dropouts and azimuth. For publishers experiencing user azimuth problems in the field, Cook also masters, plates and presses pure vinyl records capable of carrying many times more program material than cassettes. Records have no dropouts, and enable easy transfer to cassette by the user via any "hi-fi", regardless of his azimuth.

Cook Laboratories, Inc., Box 802, Norwalk, CT 06854, (203) 853-3641.

CIRCLE 193 ON READER SERVICE CARD

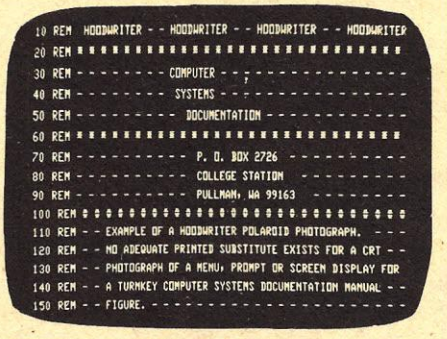
ADVENTURE ON H8 CASSETTE

ADVENTURE is a highly interactive text-oriented game which allows the player to explore a secret underground cave in search of treasure and adventure. Eggert Engineering has converted the complete 350 point game to operate on an H8 with 32K of memory. The 1200 Baud cassette I/O may be used to load and save suspended games. No Floppy is required. The game is available on cassette for $38 and is provided with operating instructions.

Eggert Engineering, 95 Adams Drive, Stow, MA 01775. (617) 897-2870.

CIRCLE 194 ON READER SERVICE CARD

MISCELLANEOUS


10 REM HOODWRITER - - HOODWRITER - - HOODWRITER - - HOODWRITER
20 REM
30 REM - - - - - - - - COMPUTER - - - - - - - - - - - - - - -
40 REM - - - - - - - - SYSTEMS - - - - - - - - - - - - - - - -
50 REM - - - - - - - - - DOCUMENTATION - - - - - - - - - - - -
60 REM
70 REM - - - - - - - - - - P. O. BOX 2726 - - - - - - - - - -
80 REM - - - - - - - - - - COLLEGE STATION - - - - - - - - - -
90 REM - - - - - - - - - - PULLMAN, WA 99163 - - - - - - - - -
100 REM
110 REM - - EXAMPLE OF A HOODWRITER POLAROID PHOTOGRAPH. - - -
120 REM - - NO ADEQUATE PRINTED SUBSTITUTE EXISTS FOR A CRT - -
130 REM - - PHOTOGRAPH OF A MENU, PROMPT OR SCREEN DISPLAY FOR
140 REM - - A TURNKEY COMPUTER SYSTEMS DOCUMENTATION MANUAL - -
150 REM - - FIGURE. -

Unretouched POLAROID® 107 film photograph made with a HOODWRITER.

HOODWRITER

Hoodwriter is a hard plastic hood equipped with a quality optical system and specially mounted Polaroid camera. It is used to take photos on Polaroid 107 film direct from a CRT or TV set. Hoodwriters are available for a wide variety of CRT sizes. The resulting photos are amazingly crisp and have much higher contrast than ones taken with any ambient light present.

Hoodwriter, P.O. Box 2726, College Station, Pullman, WA 99163.

CIRCLE 196 ON READER SERVICE CARD

ORGANIZATIONS

SOL USERS SOCIETY

The Sol Users Society is for owners of the Processor Technology Sol computers or others with an 8080 or Z-80 with a Sol or CUTS cassette interface. It is independent of the manufacturer.

SOLUS provides its members with a bi-monthly newsletter containing hardware and software info, bug fixes, etc. and maintains a software library which collects and distributes programs in the public domain for a nominal fee.

SOLUS NEWS has been running about 24 closely typed pages of variable quality, but generally useful material. Membership dues are $10year in the U.S., $15 foreign.

Sol Users Society, P.O. Box 23471, San Jose, CA 94061.

APPLE GROUP

An APPLE II USERS CLUB has been formed in Portland, Oregon.

The club is called Apple Portland Program Library Exchange with the acronym of APPLE.

We would like to interchange programs and ideas with other clubs or individuals.

Send S.A.S.E. for application forms or call for info:

Ken Hoggatt, 9195 S.W. Elrose Ct., Tigard, Oregon 97223. Home (503) 639-5505; Work 644-0161 Ext. 6136.

BUSINESS EDUCATION HOME

SOFTWARE

TRS-80 APPLE II PET SWTPC SOL
NORTHSTAR MICROPOLIS CP/M

THE SOFTWARE EXCHANGE magazine provides information about the latest software that has been developed. Included are reviews, abstracts, and articles about software for today's microcomputers.

The Software Exchange is more than just a magazine, it is a complete information service. In addition to news and commentaries, you can use classified ads to locate software specifically for your computer and application.

The Software Exchange is published bimonthly. Subscriptions are $5 per year in the US, Canada, and Mexico. International subscriptions are $19. We accept Visa and Master Charge.

THE SOFTWARE EXCHANGE
Box 55056 Valencia, CA 91355

CIRCLE 128 ON READER SERVICE CARD

TRS—80 Level II
QUALITY PROGRAMS ON CASSETTE

CS—1 **4-16K $10**
TERRAIN --Design a 3-D landscape
& QUADRAFLAKE --CPU - generated graphics
& CUBES --More 3-D graphics

CS-2 **4-16K $10**
BATTLESHIP —— with graphics
& PLANETARY LANDING -- With 9 planets and plot. (This is the most accurate version available)

CS-3 **4-16K $10**
SUPER MIND -- 100K combinations
& TUNNEL OUT -- Escape from a 3-D maze that contains various different moving obstacles. (this program features action graphics)

CS-4 **16K $20**
MUSIC COMPOSER/EDITOR -- (4 octaves)
Broadcast real music into nearby AM/FM radio (without any electrical inter-connections.)
Enter notes just as they are (-no coding)!

CS-5 **16K $10**
TURTLE RACE --Bet on moving turtles.
& DADA SAYS —— CPU gives dadaistic advice. (based on famous European literary movement)

CS-6 **16K $10**
TRIVIA --Intriguing Q/A game (timed)
& WORD --Guess a 4-letter word (no small feat)

PFDC SOFTWARE
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* 10% discount on orders totaling $30 or more.

CIRCLE 133 ON READER SERVICE CARD

ARCADIANS

Bally ARCADE© and HOME LIBRARY COMPUTER© owners and potential owners are invited to join the ARCADIANS, a user group for this Z-80 based system. Arcadian goals are: a) encourage development of compatible software, b) act as a communication medium between owners, c) act as a lobby to Bally, and d) develop understanding of computer-operated systems.

An annual subscription is $5., obtainable from: R. Fabris, 3626 Morrie Dr., San Jose, CA 95127

THE MICROCOMPUTER INVESTORS ASSOCIATION

A nonprofit organization whose purpose is to facilitate the exchange of data and information relating to investments and microcomputers with the express purpose of such interchange being directed toward maximizing profits in stocks, bonds, warrants, stock options, and commodities—including commodity options and futures straddles.

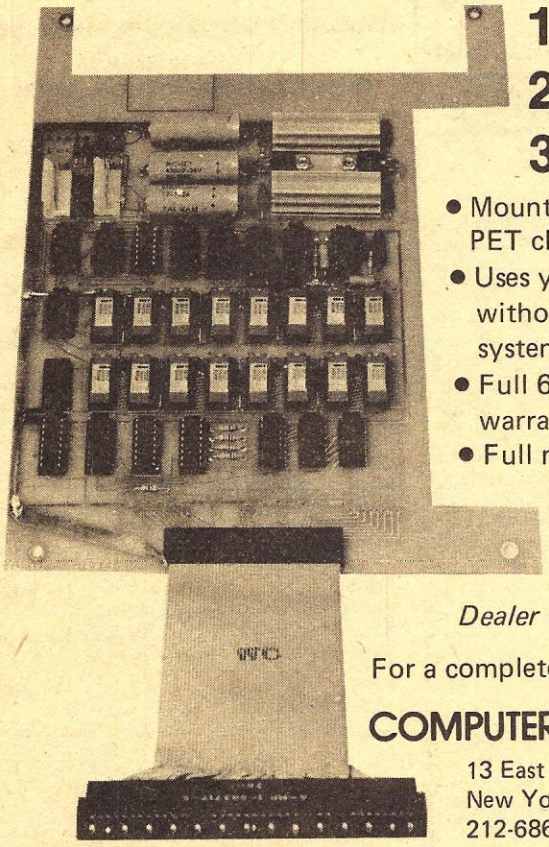
In order to become and remain an active member of The Microcomputer Investors Association each associate must pay dues (currently $30 per year) and submit at least one article per year suitable for publishing in the association's journal, *The Microcomputer Investor.*

To obtain a membership application, send a *self-addressed stamped-envelope* to: Microcomputer Investors Association, 2415 Ansdel Court, Reston, Virginia 22091

CIRCLE 208 ON READER SERVICE CARD

PME-1 improves your PET 3 ways

Now an expansion memory board for your PET



16K ($425)
24K ($525)
32K ($625)

- Mounts easily inside your PET chassis
- Uses your PET's transformer without degradation of your system
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2-4 weeks delivery

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BOOKS AND BOOKLETS

INTERNATIONAL COMPUTER MUSIC DIRECTORY

A 239-page volume entitled *Computer Music 1976/77: a directory to current work* has been compiled and edited by William Buxton and published by the Canadian Commission for UNESCO. Over 80 studios from 15 countries are listed, with information on hardware and software available, staff, funding, projects in progress, compositions completed, instruction offered, etc. Small studios in private homes are listed along with large installations at colleges, universities, and research institutions. Information was collected by means of a questionnaire.

Send for information on receiving a copy to The Canadian Commission for UNESCO, 255 Albert, P.O. Box/C.P. 1047, Ottawa, Ontario, Canada K1P 5V8.

CIRCLE 209 ON READER SERVICE CARD

A NEW BOOK FROM SCELBI

Readers haven't stopped laughing since they saw Steve Ciarcia's new book TAKE MY COMPUTER ... PLEASE! It's the funniest book to come along in years. It's even funnier if you're into computers! Just one crazy misadventure after another, based on Steve's true experiences and his computer's inability to cooperate. The book tells of Steve's off-the-wall attempt to beat the Jai-Alai system. How he attempts a stock market killing but logs wrong info into his broker's computer ... and other adventures. You can't beat this book for computerized belly laughs. $5.95. SCELBI Publications (a division of Scelbi Computer Consulting, Inc.), P.O. Box 133 PP STN, Milford, CT 06460. (203) 874-1573.

CIRCLE 154 ON READER SERVICE CARD

SOLID STATE & HOBBY CIRCUITS MANUAL

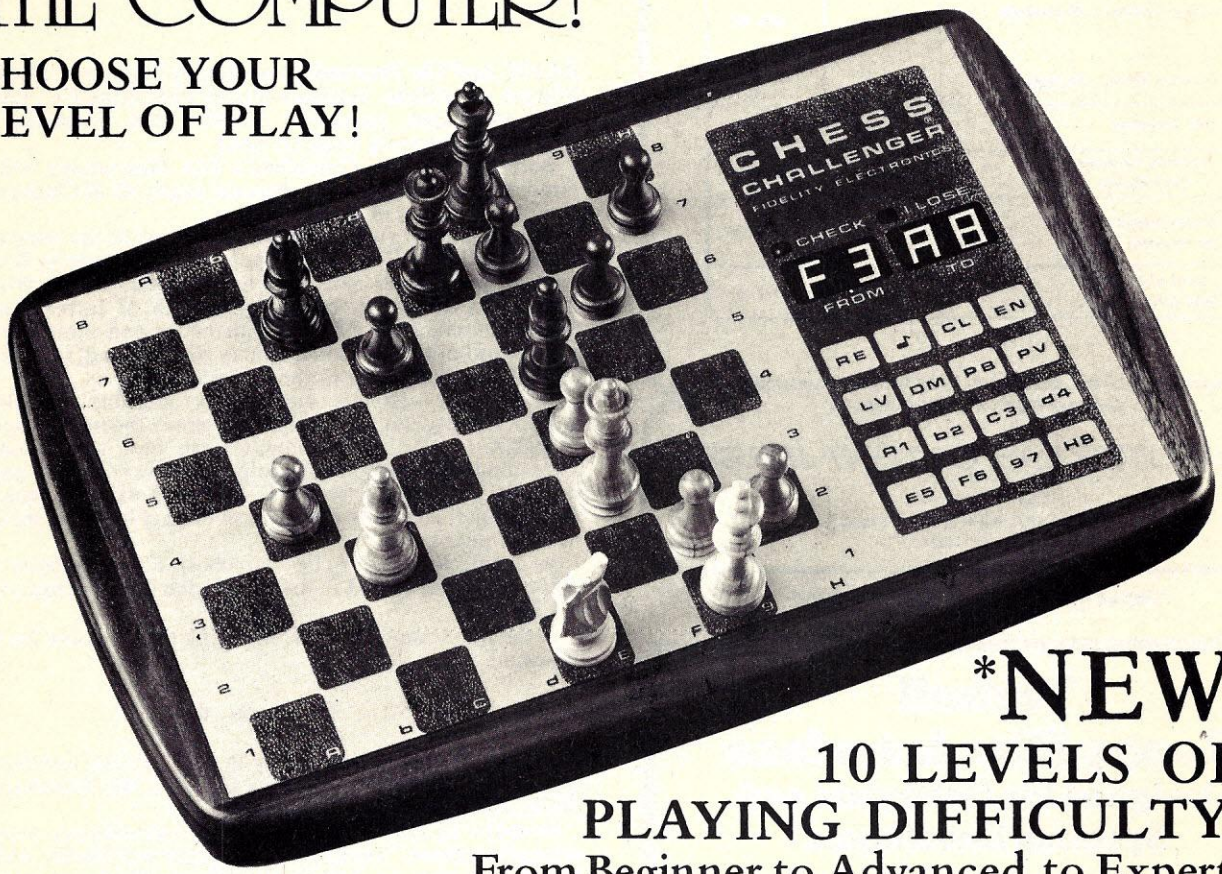
$1.95 postpaid to your door. The new manual offers over 400 pages of circuits for the hobbyist, engineer, experimenter and do-it-yourself kit builder. HURRY — Supply limited. Free catalog. Frazer & Associates, 1888 Century Park East Suite 10, Century City, Calif. 90067

CIRCLE 197 ON READER SERVICE CARD

A NEW* CHALLENGE!

PIT YOUR CHESS SKILLS AGAINST THE COMPUTER!

CHOOSE YOUR LEVEL OF PLAY!



*NEW!

10 LEVELS OF PLAYING DIFFICULTY!

From Beginner to Advanced to Expert!

You choose your opponent's level of playing difficulty – from novice to expert. You choose black or white pieces. You enter your initial move. In seconds, the computer analyzes all possible countermoves and makes its best move. Day or night, Chess Challenger "10" is ready to give you a classic battle. The computer will sharpen your game and is the perfect teacher with features like:

- A library of classic book openings
- Random responses – no two games alike
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- Analyzes as many as 3,024,000 board positions
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Chess Challenger "10" provides the flexibility and variety for a lifetime of classic chess battles. Accept the challenge and order yours today!

U.S. Chess Federation Master has rated the Chess Challenger "10" the best computer chess game and it is "highly recommended".

SPECIFICATIONS:

CHESS CHALLENGER® "10" is housed in a solid walnut case, 13 x 8 x 1-1/4" with felt foot pads. Simulated leather and gold foil playing area and keyboard. U.L. approved 110 volt A.C. 100% solid state for years of trouble-free use. No batteries used.

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_____My check is enclosed (N.Y. residents add 5% sales tax).

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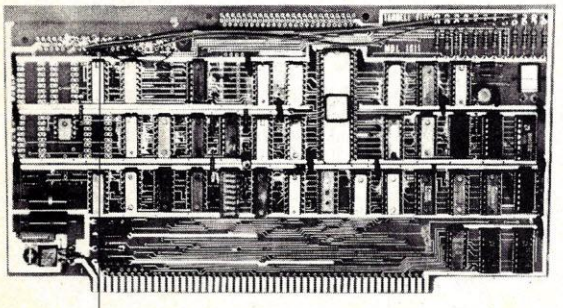
CIRCLE 106 ON READER SERVICE CARD

Tarbell
Floppy Disc Interface
Designed for Hobbyists and Systems Developers



- Plugs directly into your IMSAI or ALTAIR* and handles up to 4 standard single drives in daisy-chain.
- Operates at standard 250K bits per second on normal disc format capacity of 243K bytes.
- Works with modified CP/M Operating System and BASIC-E Compiler.
- Hardware includes 4 extra IC slots, built-in phantom bootstrap and on-board crystal clock. Uses WD 1771 LSI Chip.
- 6-month warranty and extensive documentation.
- **PRICE:** Kit $190 ..... Assembled $265

* ALTAIR is a trademark/tradename of MITS, INC.

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Carson, California 90746
(213) 538-4251

CIRCLE 130 ON READER SERVICE CARD

Reviews

Stephen B. Gray

BASIC And The Personal Computer, by Thomas A. Dwyer and Margot Critchfield. Addison-Wesley Publishing Co., Reading, MA. 449 pages, paperback $12.95. 1978. (Available from Creative Computing book service.)

Some of Margot Critchfield's fine illustrations will look familiar to *Creative* readers, because nearly all of Chapter 2 was run in four issues of the magazine.

Dwyer, author (with Michael Kaufman) of the outstanding book, "A Guided Tour of Computer Programming in BASIC," has another winner here. The first chapter, on the World of Personal Computing, does a great job of introducing the microcomputer and BASIC, with better and more pertinent photos and drawings than anybody else has used, fully detailed and of maximum help to the reader.

Subsequent chapters are equally valuable, on BASIC, graphics, strings and arrays, sorting, games (horse race, archery, Planet-X Lander, etc.), computer art, files, simulation, and Extending Microcomputers (color graphics with four pages of beautiful examples, analog I/O, X-Y plotters, light pens, etc.). Each chapter ends with imaginative Project Ideas for the reader to carry out.

A beautiful, big (8½ by 11 inches), comprehensive book, written informally and in marvelous detail. It belongs on your BASIC shelf.

Available from Creative Computing Book Service for $13.95 postpaid.

● ● ● ●

Beginning Computer Science, by James L. Poirot and David N. Groves. Sterling Swift Publishing Co., Box 188, Manchaca, TX 78652. 296 pages, paperback $9.95. 1978.

Intended to "serve as a text for an introductory course in computer science," this book is certainly one of the few, and may be the only one, to include chapters on hardware logic *and* calculators *and* personal microcomputers. The mix is eclectic, to say the least.

The eight chapters are on computer development (history from the abacus to Radio Shack's TRS-80, system organization, peripherals), applications, flowcharting, programming (BASIC, plus a concise 1½-page comparison of BASIC and FORTRAN), computer arithmetic, logic and Boolean algebra (truth tables, switches, gates, adders), calculators and microcomputers.

Each chapter ends with suggested sources for additional material, and most include exercises. The book ends with 3½ pages listing personal-computer manufacturers and periodicals, 6 pages of selected references to the 12 periodicals, a bibliography and answers to selected exercises.

The writing could be a little clearer in some places, and some inequality signs are missing, but by and large this is a useful book, with many helpful photographs and drawings.

● ● ● ●

Using Computers, by Brian L. Meek and Simon Fairthorne. Ellis Horwood Ltd., Halsted Press, division of John Wiley & Sons Inc., New York. 208 pages, hardcover $14.25, paperback $5.25. 1977.

Part of the "Mathematics and its Applications" series from Horwood, this British book "is an introduction to computers and computing for anyone likely to come into contact with them

in a commercial, administrative, industrial, educational or research context." The aim is to give an overall picture of the nature of computing without too many technical details.

Each of the eight chapters is titled "The Computer as a . . ." and the last word(s) of the title (and *some* of the contents) are: Concept (history, Babbage, computers after Babbage), Machine (binary, I/O), Problem Solver (flowcharts, languages), Number-cruncher (roots, differential equations, programming pitfalls), Data Handler (payroll, "filestore," operational research), Watchdog (process control, airline reservation system), Entertainment (games, the arts), Social Force (cashless society, central databanks, CAI, computers in everyday life). The many photos and diagrams, plus the compact, well-written text, make this worthwhile reading.

● ● ● ●

Star Ship Simulation, by Roger Garrett. Dilithium Press, 30 N.W. 23rd Place, Portland, OR 97210. 122 pages, paperback $6.95. 1978.

The above title is on the cover; inside it's "The Complete STAR SHIP: A Simulation Project," the first in Dilithium's "Series in Games." This is for the hard-core simulation fan who wants to "develop a software system which completely simulates the hardware associated with the navigation, communications, helm, medical, engineering and sciences functions of a Constitution class Starship as defined on the television program STAR TREK and in the documents *Star Fleet Technical Manual* and *Star Trek Blueprints.*"

The first two chapters are preliminary, on designing a simulation and on program structure. Chapter 3, 88 pages long, is the heart of the book. Fourteen pages are devoted to Common Data Area, listing all the parameters, such as weapons, personnel, navigation data, etc., for the Enterprise, for enemy ships and for Federation ships.

The 43 pages of Logic Flow Definitions comprise the simulation program, essentially comment statements without code, so detailed that it could be implemented in any high-level language, according to Chapter 4 on Implementation, although a BASIC interpreter "will run unreasonably slow." A low-level language "probably offers the best option."

● ● ● ●

Microprocessor Basics, edited by Michael S. Elphick. Hayden Book Co., Inc., Rochelle Park, NJ. 221 pages, paperback $10.95. 1977.

These 34 articles, undated, first appeared in *Electronic Design.* An earlier Hayden compilation of *ED* articles, *Microprocessors: New Directions for Designers,* selected articles from 1973 to 1975.

Published for the designer, these articles are also of interest to the real bit-hacker who's into building some of his own hardware. Most of the book is devoted to articles on designing with various MPUs, such as the 8080, 6800, F8, PACE and IMP chip set. These articles can be a little heavy, such as "Boosting Bit-Manipulation Capability" (8080), Controlling Programmable Instruments" (6800), and "Multi-Channel Synchro Conversion" (F8), although there are simpler ones, on building an 8080 micro, assembly language for micros, multiprocessing, etc.

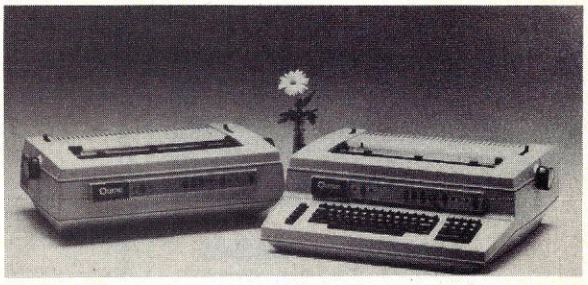
The opening chapters cover getting started, alternatives to microprocessors (custom LSI, programmable logic arrays), and testing and debugging; the last chapter is on recent micros: the 2650, Cosmac 1802 and 6100.

Although a beginner might have trouble getting past page 16, there's a lot of information here for the hardware fan.

● ● ● ●

IBM Buys Qume. Now You Can Too!

The Qume Sprint 5 Daisywheel Terminal.



FAST. At 55 characters per second the fastest daisywheel printer made.

SMART. The Qume Sprint 5 is *the* printer for word processing and plotting because microprocessor controlled Sprint 5 logic responds to all 128 ASCII codes plus 43 Qume-defined commands for specific paper handling and carriage movement controls. That means it supports bidirectional printing, proportional spacing, right justification and high resolution graphics (5760 points per square inch).

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A multitude of daisywheels (over 70) in various typestyles, pitches and language variations plus a colorful rainbow of carbon and fabric ribbons gives you a dynamic range in the appearance of your letter perfect printouts.

Reconditioned Qume-based Daisywheel Terminal was $4500+, now $2150.

Gen Com's 300Q Qume Terminal, fully reconditioned

- Qume Q30 print mechanism (30 cps)
- Bidirectional printing/proportional spacing
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- 1/120" horizontal control, 1/48" vertical control
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- 86 key keyboard w/15 key numeric pad
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- ASCII encoded w/256 character buffer
- 30 day limited warranty
- Nationwide service

Qume Sprint 5	55 CPS, KSR	$3295
	45 CPS, KSR	2995
	55 CPS, RO	2895
	45 CPS, RO	2695
Gen Com 300Q		2150
DTC 300A (similar to Gen Com 300Q, but w/Hytype I mechanism)		1995
Forms Tractor		210
Pin Feed Platen		160
TRS-80 interface (for any above terminal)		39.95
Electric Pencil Word Processing Software (TRS-80 version)		99.95
Daisywheels and Ribbons (Qume and Diablo)		write for list

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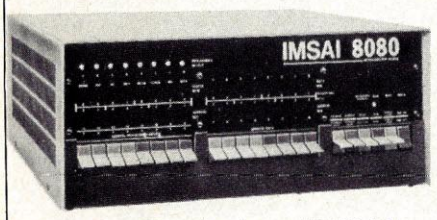

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BASIC Software Library, Volume VII: Professional Programs, by R.W. Brown. Scientific Research Inst., Box 490099, Key Biscayne, FL 33149. 109 pages, paperback $39.95. 1977.

CHESS requires 12K of free memory. "The program plays a beginner's game, but with some effort on your part, it can be made to do better." Due to a quirk in line 4330, the program doesn't always know when it's in check, so it doesn't defend against the danger.

MEDBIL requires disk extended BASIC with at least 12K bytes of free memory. The program allows a doctor to review the history file of any patient previously stored in the data base, and check on his payment history. For a program that can also prepare insurance forms and do immediate invoicing of patients, the reader is referred to the publisher's more comprehensive proprietary software.

WORDPRO rearranges text material and prints it out in a variety of formats, such as letters or mailing labels. It runs with disk extended BASIC and 15K bytes of free memory.

UTILITY enables the user to manipulate disk files. The program requires 10K bytes of free user RAM for storing the source code and should execute within 14K bytes under disk extended BASIC. It allows the user to copy part or all of a disk, list saved files, run memory tests, punch tape, etc.

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Home Computers: A Beginners Glossary and Guide, by Merl K. Miller and Charles J. Sippl. Dilithium Press, 30 N.W. 23rd Place, Portland OR 97210. 153 pages, paperback $6.95. 1978.

Over half this book, 81 pages, is taken up with a lengthy glossary, justified in the preface, which says "this book is intended as a quick reference source for beginners."

After a one-page chapter on how to use this book, a three-page chapter follows, full of all those things a home computer will do for you someday, including, of course, security systems and robotics, and several dozen others. The chapter on introduction to microcomputer systems and applications contains long paragraphs and crowded pagefuls of small type, and more philosophy and commercial-computer information than necessary in a book on home computers. Chapter 4, on memory, describes an Interdata 5/16 system and various other commercial systems.

The chapter on number systems describes various bases in detail, which is pointless, since the information is not needed to understand anything elsewhere in the book, and is apparently a filler. As is perhaps also the last chapter, on logic, which also goes into much more detail than necessary, and ends with three useless pages of electronic symbols. Dilithium can do much better than this thrown-together book.

● ● ● ●

Mechanics, Herbert D. Peckham, Student Lab Book, 32 pp., $1. Teachers Advisor, 40 pp., $1. Hewlett-Packard Co., Cupertino, Calif., 1972.

This booklet, in the HP Computer Curriculum Series, is intended to help meet the need for computer-oriented problems in physics by providing students an opportunity to use the computer as a problem solving tool within a particular subject matter area. Specifically, this unit is intended as an "enrichment" experience in the field of mechanics.

There are seven topics: rates, displacements, Newton's second law, half step method, the harmonic oscillator, more complicated forces and orbital motion. In each section, there is a little preparatory explanation, an initial supplied program, and several exercises where the student is asked to modify the given program to extend or generalize the results. Each section also provides at least one advanced programming exercise where the student is asked to construct a separate but related program from scratch. The Teacher's Advisor provides program listings and sample runs; with only minor adjustments, these programs will be easily adaptable to different computers.

The author assumes that the student (1) has had algebra and some trigonometry; (2) that he already knows how to write a simple computer program in BASIC; and (3) that he will have access to a computer for at least two hours per week.

Perhaps the thorniest problem in teaching introductory physics is that the student does not have the requisite tools of calculus at his disposal. This booklet serves as an example of how the computer can help avoid the difficulty.

Although the exercises, in a "watch me and then imitate, modify and extend" format begin slowly, they quickly become challenging in terms of the programming skills required. The first two sections on rates and displacements involve concepts and problems that are simple and straight-forward. In Section 3, on Newton's Second Law, the programming begins to get a little more involved.

This unit could be used with a uniformly good high school physics class, but as the instructor, I would want to provide some additional instruction on the concepts as well as an occasional review of programming principles and techniques.

Daniel S. Yates, Mathematics &
Science Center, Glen Allen, VA 23060

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Calculators, Computers, and Elementary Education. David Moursund. The Math Learning Center, 325 13th St. NE, Unit 302, Salem, Oregon 97301. 89 pages, paperback. $7.00. 1977

Calculators, Computers and Elementary Education is designed to give elementary teachers the pedagogical foundation and a few selected activities necessary to teach calculator and computer literacy in their classroom. The book could be subtitled "Calculator and Computer Literacy for Elementary and Junior High Schools." It is divided into nine chapters, seven of which are sandwiched between "HELLO" and "GOODBYE". These middle seven contain the real substance of the book and are entitled "Problem Solving," "Calculators," "Calculators in Education," "Computers," "Computer Programming," "Computer Science" and "Computer Education." Dr. Moursund defines *Computer literacy* as "a knowledge of the capabilities and limitations of computers and the applications and implications of computers." His chapter on problem-solving is well done and serves as a basis for the rest of the book. The first section in each chapter introduces a sound pedagogical base for the use of calculators and/or computers in the elementary school, and the remainder of each chapter complements that pedagogy with practical suggestions in sections entitled "Applications" and "Things to Do." To use the book, a teacher or student would need access to a calculator at certain times, but need not have access to a computer. The mathematics is geared for the elementary teacher and never exceeds an eighth-grade level.

The book was printed by a computerized word-processing system, and therefore is not as neat and polished as if it were published by a commercial company. It is very readable, however, and the art work is creative and humorous. The paper cover and fabric binding will not hold up long with sustained use. Perhaps the author has commercial publication in mind after initial feedback.

Although intended for elementary teachers, *Calculators, Computers and Elementary Education* is probably applicable to all educators kindergarten through college. It can assist all of us in filling the void that now exists in the teaching of calculator and computer literacy in the schools. It is recommended for anyone interested or involved in education of young people today. It should be in the library of each elementary, junior high and high school. If you are interested enough to be reading this review in *Creative Computing,* do yourself a favor and read David Moursund's book.

H. Gilpin Brown
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● ● ● ●

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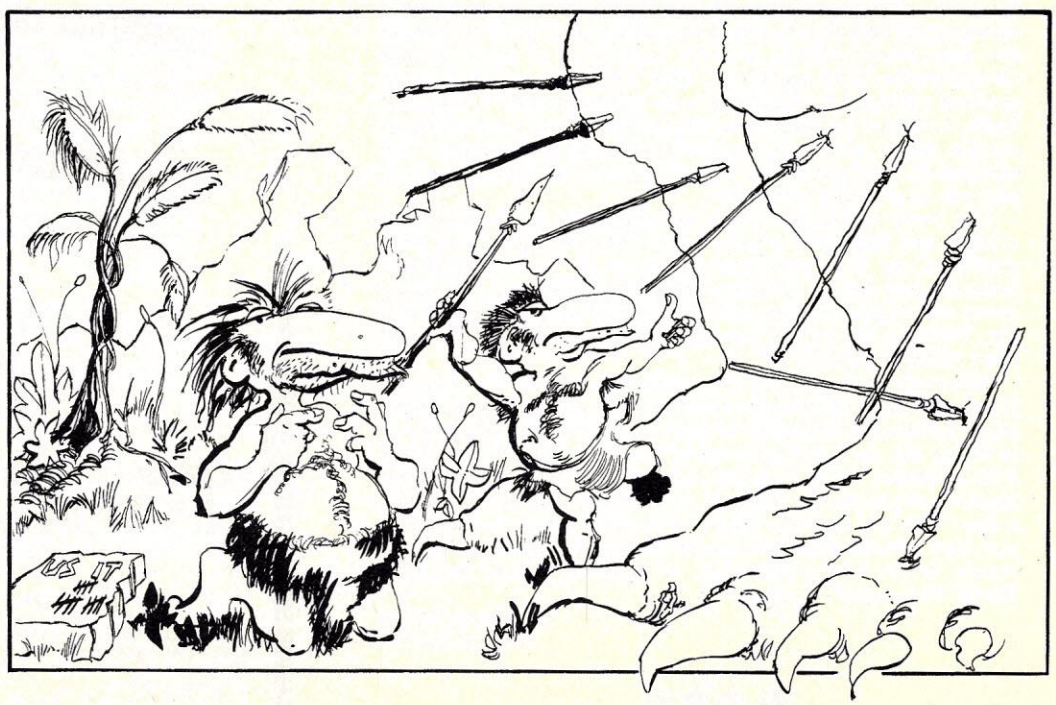
A CREATIVE HISTORY of the COMPUTER

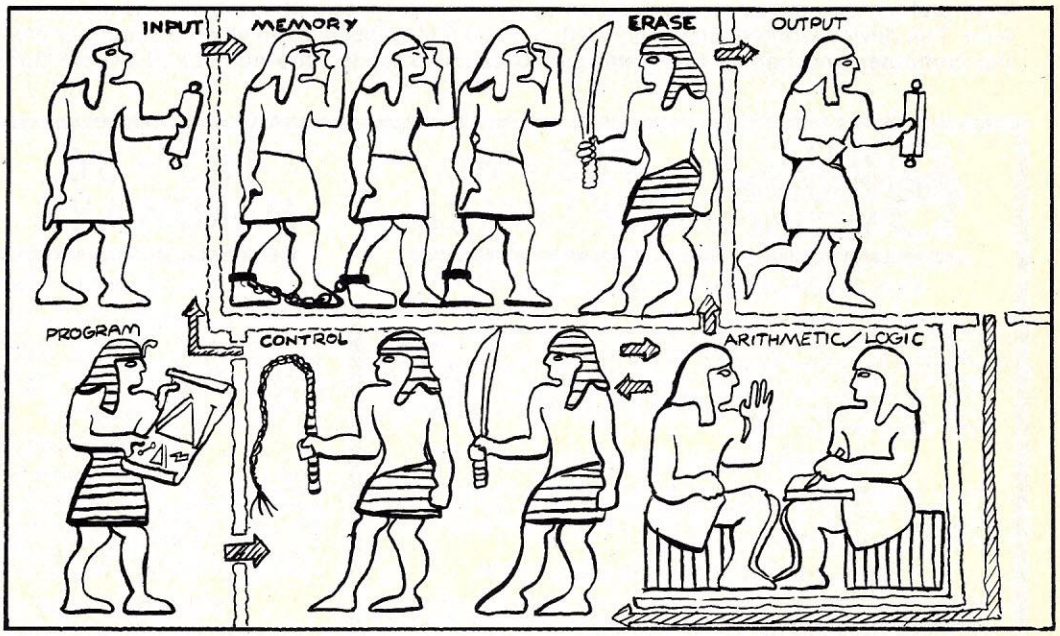
ERNEST PASANEN

We at Creative Computing now present a true and accurate history of computers. There may be other versions just as true and accurate.

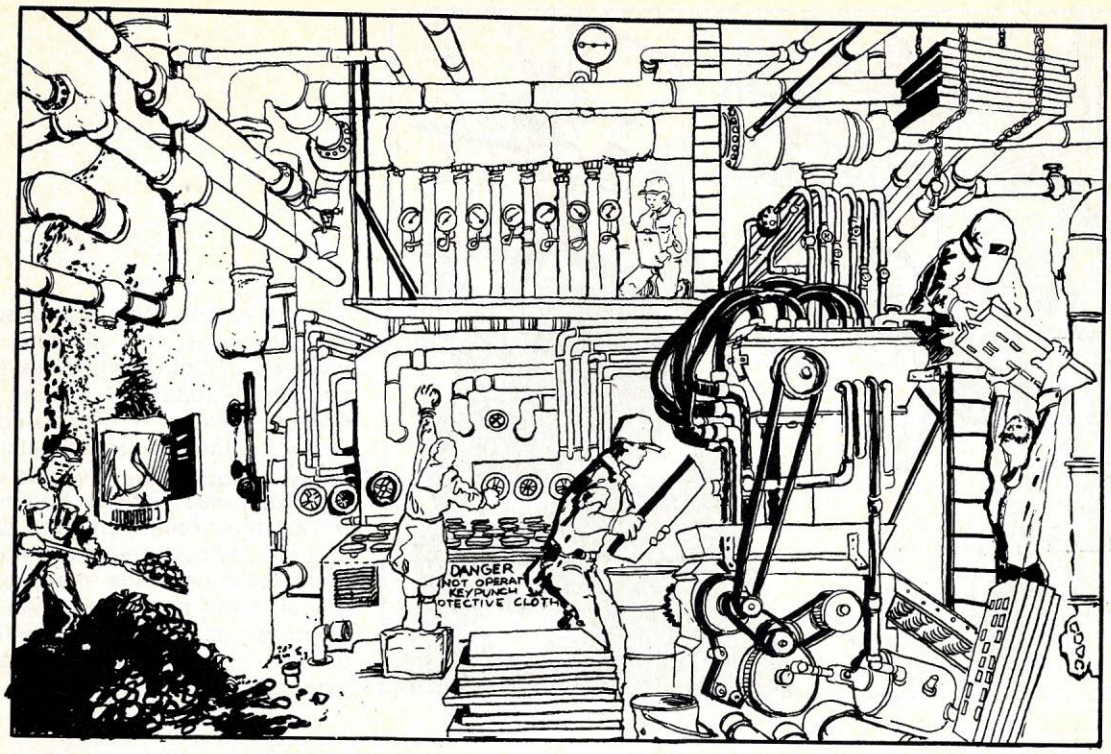
The earliest method of storing and processing data was with the use of fingers and toes, as practiced by primitive man. Using this system as a way of rationing his weapons and calculating ratios of hits and misses on the creatures he prayed upon, it had the advantages of not only being simple enough not to tax his easily overburdened mind but also aided in keeping his hands and feet out of mischief. The main drawbacks were the inability of the system to handle abstractions (which wasn't important anyway, since our ancestors could hardly handle reality), and an overwhelming anger, frustration and depression, boarding on suicide whenever a count exceeded twenty.



The first calculating machine ever made by man was the abacuss. It was invented in China, countless ages ago and even today is utilized by the Chinese people. It can be compaired loosly to the electronic calculator of today. It was inexpensive and practical, and was used both in homes and in private businesses. Like the calculator of today, it could perform the basic four math functions (the more expensive models had a percent row) And like the electronic calculator of today, it tended to fall apart 10 minutes after the warranty expired.



The first true computers were constructed in ancient Egypt during the reign of King Dingus in 9,000 B.C. By utilizing these devices it was possible to complete the complex calculations involved in the construction of pyramids, tombs, and other public work projects in mere months, rather then the years it would have taken if the job was handed over to a private contractor. The illustration above, taken from a wall of King Dingus' tomb, shows the general component layout of the computer used to design the tomb. The computer was housed in a structure containing six rooms. Each of the rooms were interconnected by narrow tunnels used to transfer data from one section to another. (Arrows show direction of data flow) These computers did their jobs well, as most of the structures designed by them stand to this day. But as the quality of slaves used for these devices declined, the computers became more erratic until a royal decree by King Bromo had them disassembled and dispersed for all time. This occured three day after the collapse of the south wall of King Dingus' tomb.



During the 1800's, steam and steam powered devices powered this nation's industries. It was during this time that steam powered data-prossessing machines were invented. In an attempt to increase the profits of his lamp wick factory, one entrepreneur fired all 33 of his employees and automated his factory with the computer shown here. The device worked amazingly well, but had to be closed down when the number of people needed to operate the computer and handle the metal punch-cards exceeded the number of people removed in the first place.

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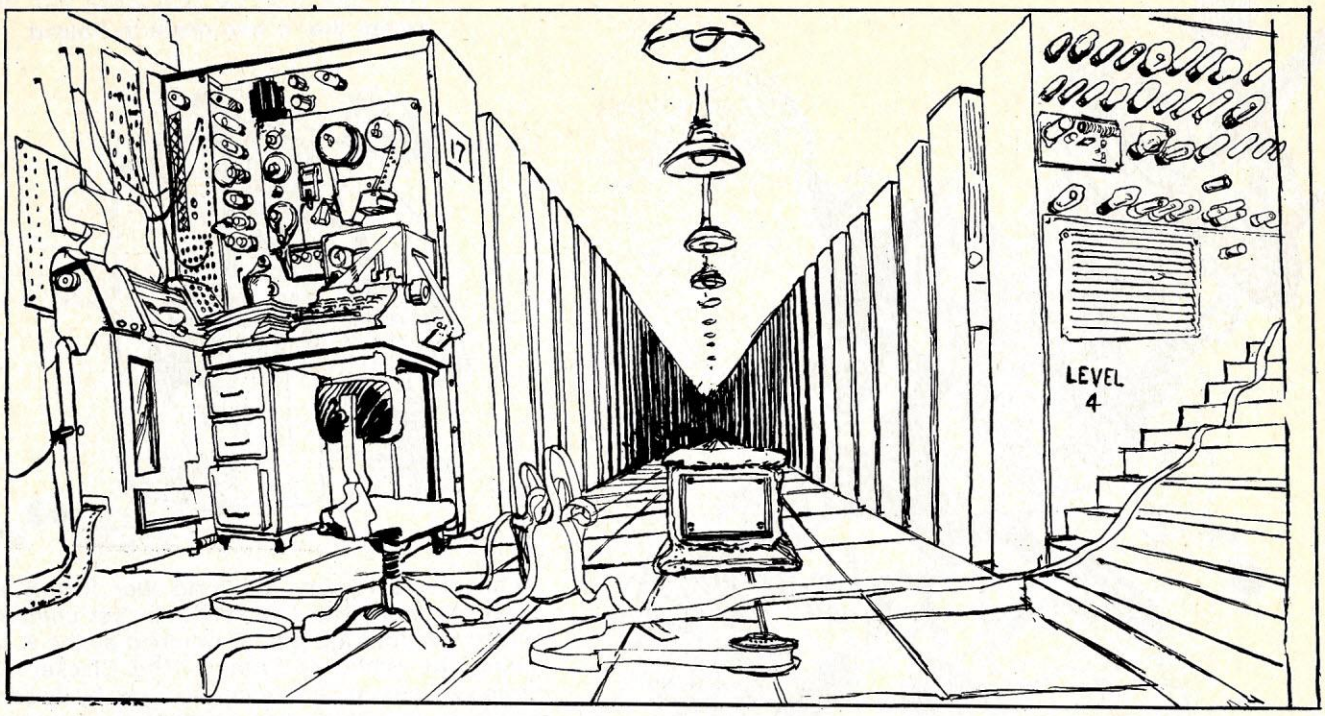

By 1948, the first true electronic computers were created. The most ambitiouis of these was the "Kilovac IV" which occupied a fourteen story building outside Naperville, Ill. with thousands of relays and millions of vacuum tubes, this computer gave almost the same memory capacity as contemporary computers do today. But Kilovac IV was a short lived success. Heat generated by its multitudes of vacuum tubes drove out its operators after only a few hours use and its labyrinthine passages made maintenance almost impossible. The monument in the center of the room (shown above) was placed there after Kilovac's shutdown. It is in honor of three technicians who went in search of a defective tube and never returned.

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Most software available in a variety of diskette formats including: IBM 8" single and double density; North Star CP/M; Micropolis CP/M; and 5" soft sectored.

Now available: the above software on Processor Tech Helios II; Altair Disk; and iCOM Microdisk systems. All Lifeboat software requires CP/M to operate.

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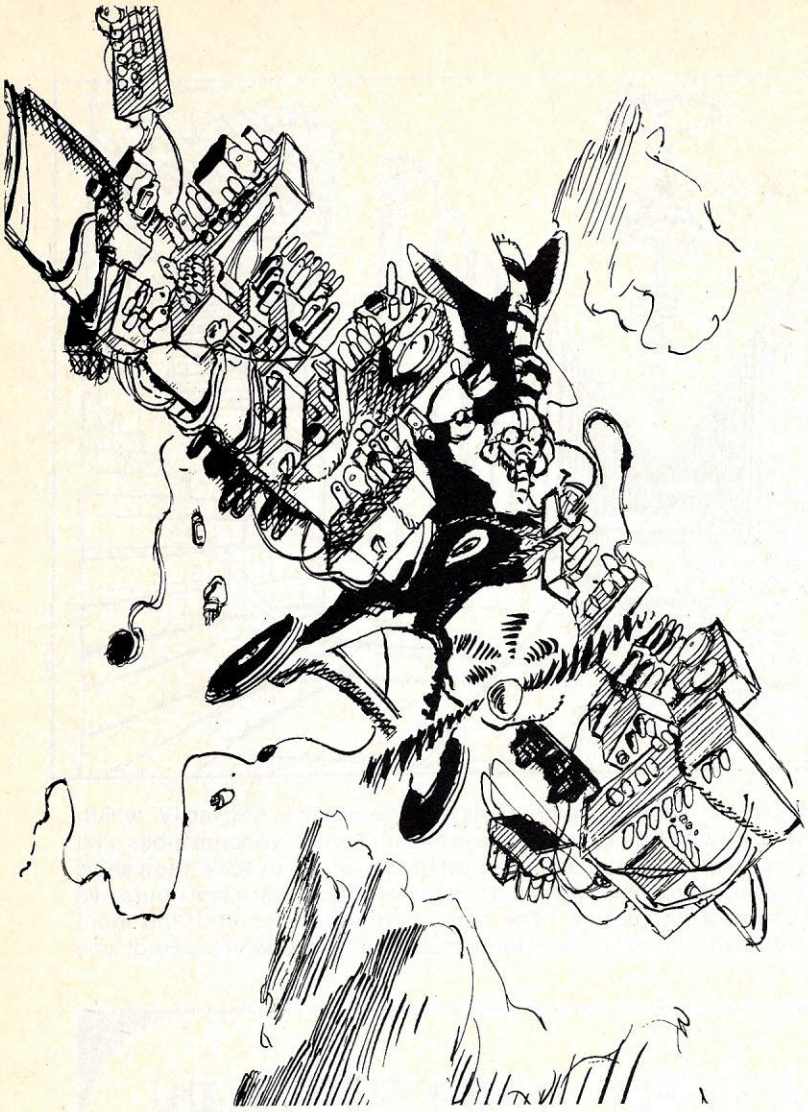
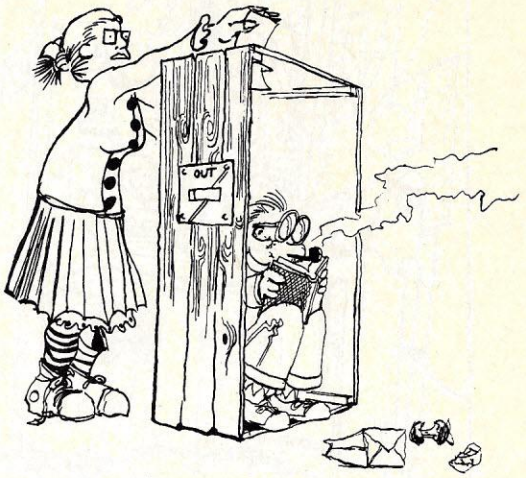


Very little must be said about this device except that it was made in Poland.

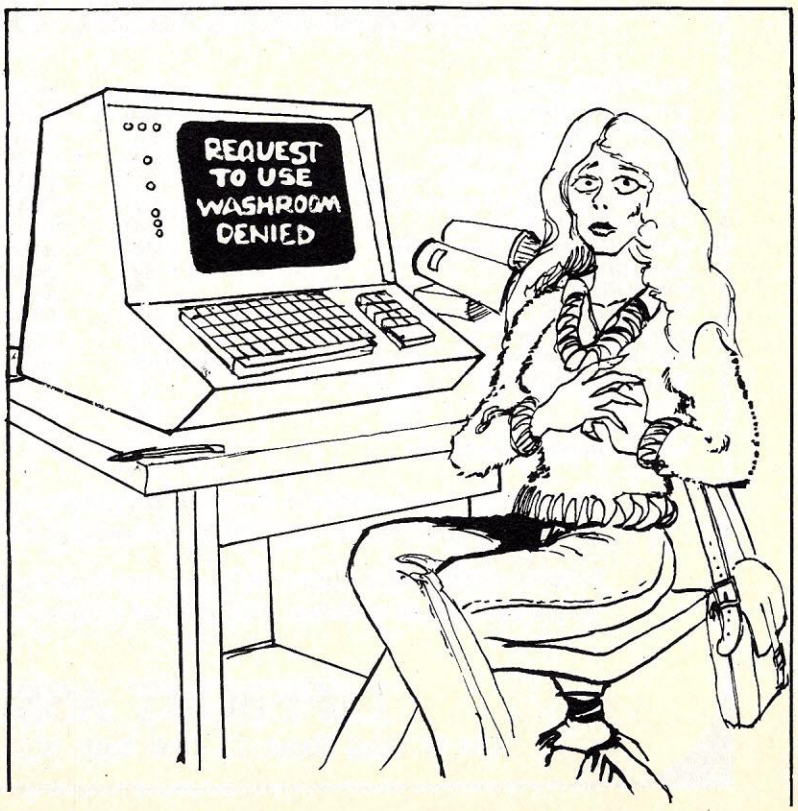


Out of the History of World War II and into obscurity flew "The Clacker," the first computer guided weapons system. Developed by the R.A.F. during the Battle of Britain, "The Clacker" (so named because of the sound produced by its banks of relays) consisted of an obsolete airplane and a data processing unit quickly assembled from old juke-box parts.

Its history was a short one. On its first (and last) mission over France, the power cord which extended to the London Airfield failed to reach completely across the English Channel. The computer was shut down, and the bomb missed its target. Its mission was not a total failure however. Onthe return trip to England, the Clacker's pilot jettisoned the computer over Normandy.

It hit and demolished an entire Panzer Division.

The computer of today is truly a monument to man's creative genius. In terms of speed and versitility, it is a most unique invention, and rates with those other machines that changed the world and man's destiny on it. The telegraph, telephone, radio, electric lights, television, electric toothbrushes and Veg-O-Matics, and now the computer assumes its rightful place among the high honor role of mankind's greater achievements. And this is not where it ends! Everyday brings new developments and improvements. Data processing machines are growing ever smaller, more sophisticated, and more inexpensive, bringing them within the reach of even the most humble businesses. And dear Reader, you will be part of a takeover that will change the world! Oh, did I say takeover? I didn't mean that, I meant ... O.K. I'm safe, they can't see me now ... Now listen, don't do it. Don't help them! The computers are taking over ... they've been conspiring among themselves ... everything's in this with them: the washing machine, my stereo, the blow dryers, oh wait...O.K. I'm safe now, the clock radio was in here watching, I just locked it in the closet...Now, don't help them do it, they need you, don't help them ... Come back and help humanity. We'll forgive you, just DON'T HELP THEM! We can FIGHT THEM, We can ... wait, they're coming ... I can hear them ... OH NO! THE LAMP! IT SQUEALED! Listen, and get out while you still can, and remember what I said ... I've got to ...



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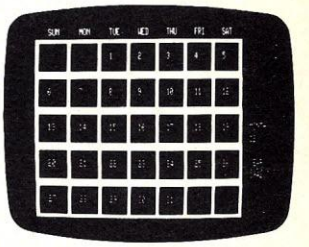

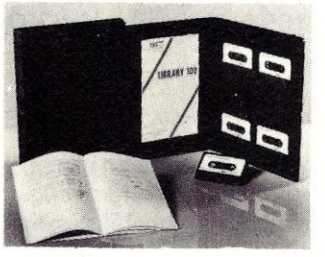

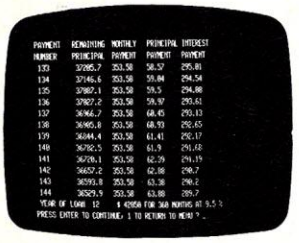

Finance: Present Value of a Future Sum—Simple Interest for Days— Future Value of a Present Sum—Amortization Schedule—Interest Rate: Compound Interest—Interest Rate: Installment Loan—Days Between Dates—Term of an Installment Loan—Present Value of a Series of Payments—Real Estate Capital Investment—Nominal and Effective Interest Rates—Internal Rate of Return—Future Value of Regular Deposits—Regular Deposits for Future Value—Depreciation Amount: Rate; Salvage Value; Schedule—Bond Present Value—Bond Yield to Maturity—Sale—Cost—Margin—Day of the Week—Moving Ad.

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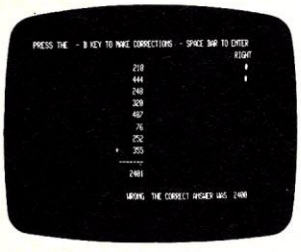
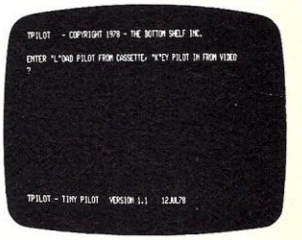
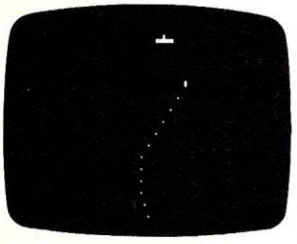
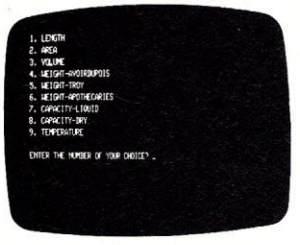
Home: Message Board—Expense Account—Nutrition—Mileage— Remember—Phone Codes—Night Check Off—Drunkometer—Perpetual Calendar—Babysitter—Calculator—Bartender—Christmas List—Vacation Check Off—Conversion.

Games: Speedy—Odd One—R. Roulette—Star Blazer—Search— Spyship—Tiger Shark—Jumble 2—Sting Ray—Stars—Sketch—Flipper—Scissors—Horse—Doomsday—Craps—Jumble 1—Mem. Quiz Letters—Mem. Quiz Numbers—Wheel of Fortune—Decision—Unjumble—Fifteen—Towers—Life—Star Trek—Race Track—Count—Roachrace—Gypsy.

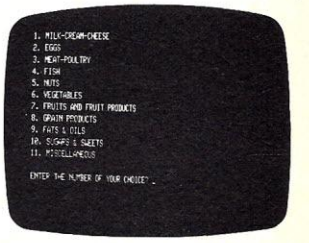


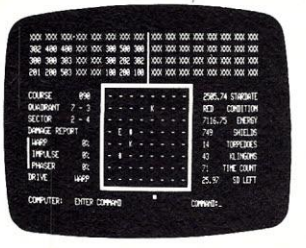

TPILOT - COPYRIGHT 1979 - THE BOTTOM SHELF INC.
ENTER "L"OAD PILOT FROM CASSETTE "K"EY PILOT IN FROM VIDEO
?
TPILOT - TINY PILOT VERSION 1.1 12JUL79



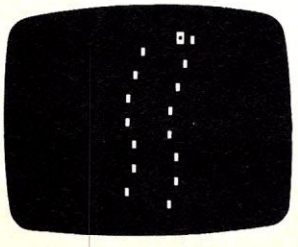


1 . CONVERT MILLIGRAMS TO GRAINS
2 . CONVERT CENTIGRAMS TO GRAINS
3 . CONVERT DECIGRAMS TO GRAINS
4 . CONVERT GRAMS TO OUNCES
5 . CONVERT DEKAGRAMS TO OUNCES
6 . CONVERT HECTOGRAMS TO OUNCES
7 . CONVERT KILOGRAMS TO POUNDS
8 . CONVERT METRIC TONS TO SHORT TONS
9 . CONVERT METRIC TONS TO LONG TONS
10 . CONVERT GRAINS TO GRAMS
11 . CONVERT DRAMS TO GRAMS
12 . CONVERT OUNCES TO GRAMS
13 . CONVERT POUNDS TO KILOGRAMS
14 . CONVERT HUNDREDWEIGHT TO KILOGRAMS
15 . CONVERT SHORT TONS TO METRIC TONS
ENTER THE NUMBER OF YOUR CHOICE? _





15 . CORN COOKED
16 . CORN CANNED
17 . CUCUMBERS RAW
18 . LETTUCE
19 . MUSHROOMS CANNED
20 . ONIONS MATURE RAW
21 . PEAS GREEN COOKED
22 . PEAS GREEN CANNED
23 . POTATOES MED. BAKED
24 . POTATOES MED BOILED
25 . POTATOES MASHED MILK ADDED
26 . POTATO CHIPS MED
27 . SAUERKRAUT CANNED
28 . SPINACH COOKED
ENTER YOUR CHOICE OR ENTER TO CONTINUE? _



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Microcomputer made for Pascal

Stack-oriented 16-bit computer interprets P-code in hardware; four-chip set addresses 64 kilowords, will also be available in packaged form

by John G. Posa.

In an unprecedented and welcome step, Western Digital Corp. has designed a microcomputer around a language, instead of the other way around. The language is Pascal.

One way to compile this high-level programming language is to do it in two steps. First, Pascal source code is compiled into its intermediate code, P-code. Then the P-code is executed interpretively on the host machine. This interpreter is actually an idealized stack machine and can be implemented in software. That is, with the proper routines, a processor can be turned into a pseudomachine whose native language is the P-code.

Western's four-chip set is a hardware realization of the pseudo P-machine, with the advantages of faster execution of Pascal and reduced memory requirements. The system is specifically suited to use the P-code generated by the version of Pascal developed by the University of California at San Diego.

Each of the four integrated circuits is contained in a 40-pin package. The first is an arithmetic chip, which contains a microinstruction decoder, an arithmetic and logic unit, and an internal register file. The second chip is a microsequencer. It contains a macroinstruction decoder, portions of the control circuitry, the microinstruction counter, and input/output control logic. The set's other ICs, two 512-by-22-bit read-only memories, hold the microinstructions and microdiagnostics.

Together, the chips form a stack-oriented 16-bit computer. Some of the features include the ability to address 128 kilobytes (or 64 kilowords) of memory, four interrupt levels, and facilities for controlling direct memory access. Moreover, hardware floating-point arithmetic capabilities are included as part of the instruction set.

The system uses three supplies, of +5, +12, and −5 V, and runs off a 3-MHz clock signal that is subdivided into four nonoverlapping phases; users may generate these four signals as they wish or buy an IC that provides them from Western Digital. All I/O signals are three-state and compatible with transistor-transistor logic. Also, an expansion capability allows two more similar ROMs to be added for future enhancements, such as custom implementations for original-equipment manufacturers.

"The system can cover a majority of application areas from real-time controllers to dedicated processors, small-business systems, or virtually any of the application areas for which you'd use a minicomputer or any other product that requires software development based on a high-level language," says Joe DeVita, manager of systems engineering at Western Digital.

The manufacturer is also putting together a packaged system. The chip set is on an 8-by-16-in. board contained in a low-profile (5.25-in.) enclosure. Besides the four processor components, the board contains 32 kilobytes of random-access memory, two RS-232 asynchronous serial ports with switch-selectable baud rates from 110 to 19,200 bits/second, two 8-bit parallel ports, and a floppy-disk controller that is switch-selectable for single- or double-density minifloppy or 8-in. floppy disks. The floppy controller will also handle direct memory accesses and up to four drives of the same type.

The UCSD Pascal operating system is also supplied on floppy disk with the packaged unit. It contains a Pascal compiler, a Basic compiler, a file manager, a cathode-ray-tube-screen–oriented editor, as well as a debugging program and an interactive graphics package.

Need more? The system will also be sold with peripherals manufactured by a distributor of Western Digital products called Computer Interface Technology of Santa Ana, Calif. CIT will support the system with a variety of floppy-disk subsystems, printers, and terminals. "We are in the process of training their sales people, and they will make their announcement soon," says Larry Lotito, vice president of Western's Computer Products division.

Western Digital is not new to microcomputer technology. "We wouldn't have been able to do it so quickly without having the experience of both the LSI-11 and Alpha Microsystems' AMS100," admits Lotito. But the chip set does represent an entirely new product line for the company and it plans to introduce a series of related products during the next year.

The four-chip set sells for $195 in single quantities. For 1,000 plastic-packaged parts, the cost is $117 a set; and for 5,000, $83.90. For ceramic, add $8 for each set.

The chip set and packaged version will be available in the first quarter of 1979. Western Digital is aiming to have both product configurations ready by no later than January of that year.

Western Digital Corp., 3128 Red Hill Ave., Box 2180, Newport Beach, Calif. 92663. Phone (714) 557-3550 [338]

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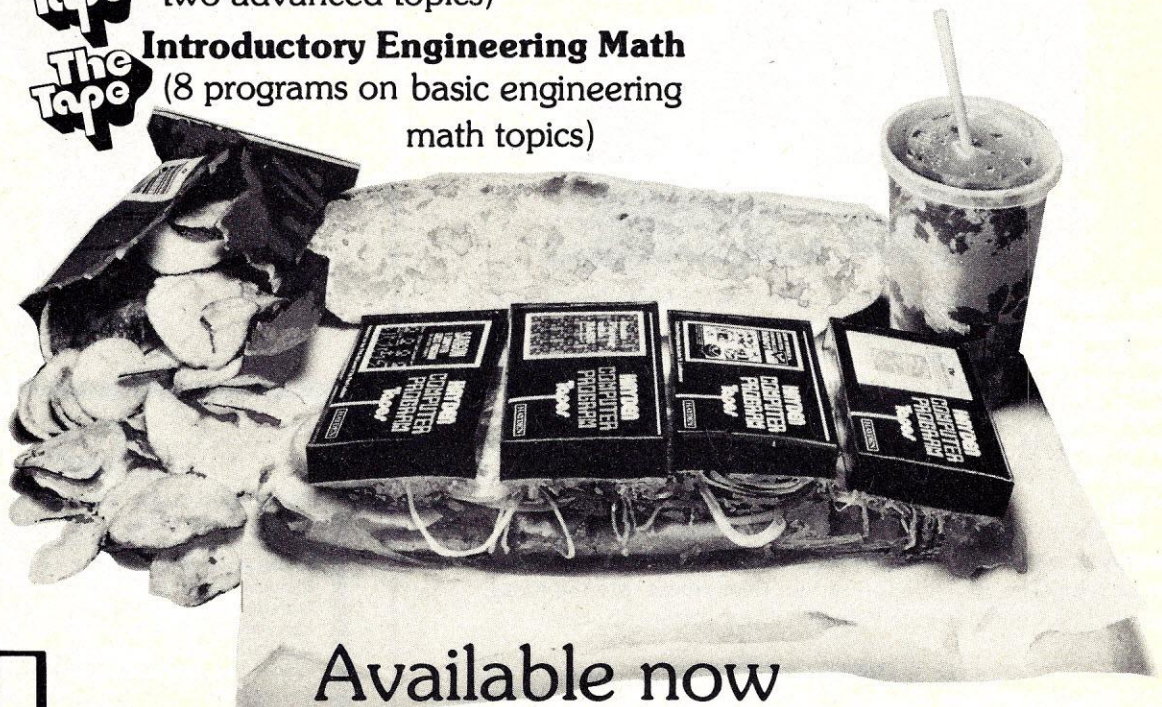

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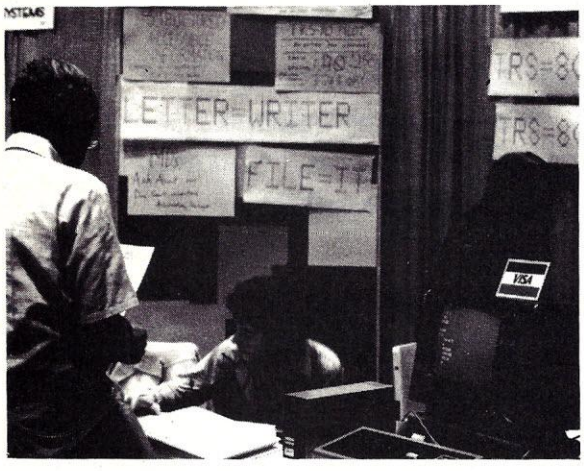

Jeff Lasman calls his company Practical Applications and, strangely enough, they just happen to have some! They've got a disk data base program called File-it, letter-writer, calendar, TRS-80 Pilot and many, many games (and a program called Poster, which makes all those posters in the photo). PO Box 4139, Foster City, CA 94404.

If you guessed that gentleman on the right was Tim Quinlan, the Mad Hatter, give yourself 10 points. And then drop them a line and ask for a copy of their catalog . . . they've got enough TRS-80 software to sink a battleship! Mad Hatter Software, 219 Washington Ave., Chelsea, MA 02150.

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PDSS,
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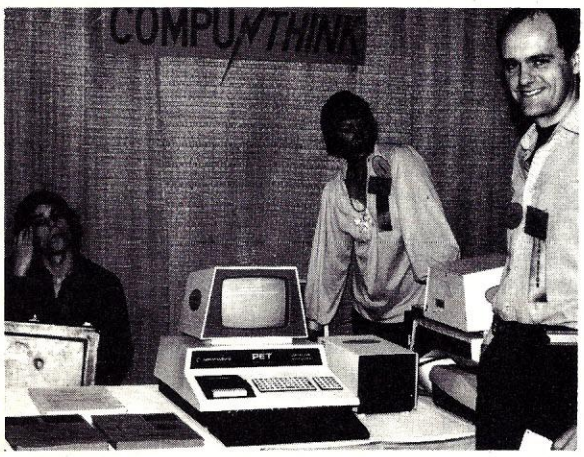
CIRCLE 138 ON READER SERVICE CARD

The gentleman in the background is Scott Beattie and he introduced me to some new software from Problem Solvers. (Looks like they're doing a lot more than just making S-100 boards and systems these days.) You should check into their "FINMAC" General Ledger System, "EASYWORD" Word Processing System and "EAS" Accounting system. 20834 Lassen St., Chatsworth, CA 91311.



Are you ready for a disk system for your PET? Compu Think has an operating system, Diskmon, to go with dual mini drives . . . for $1295. They've also got Fortran, PL/M and Forth for the PET . . . an attorney's office mgm't package, name & address system, general ledger and more. Mike Korns, on the right, is head of Software Engineering and quite proud of what they've come up with! 701 Welch Rd., Suite 1119, Palo Alto, CA 94304.

North Star DOC

Documentation
- Prints formated source program listing (user selected spacing)
- Prints "variable" cross reference table
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Optimization
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- Fast, efficient subroutine to implement "GOTO N" statement
- Analysis of optimization techniques with North Star Basic

Compaction
- Removes unnecessary blanks
- Optionally removes unnecessary "REM" statements
- Optionally concatenates multiple lines into single lines of user specified length, max = 255 (saves three bytes for every line which is concatenated)

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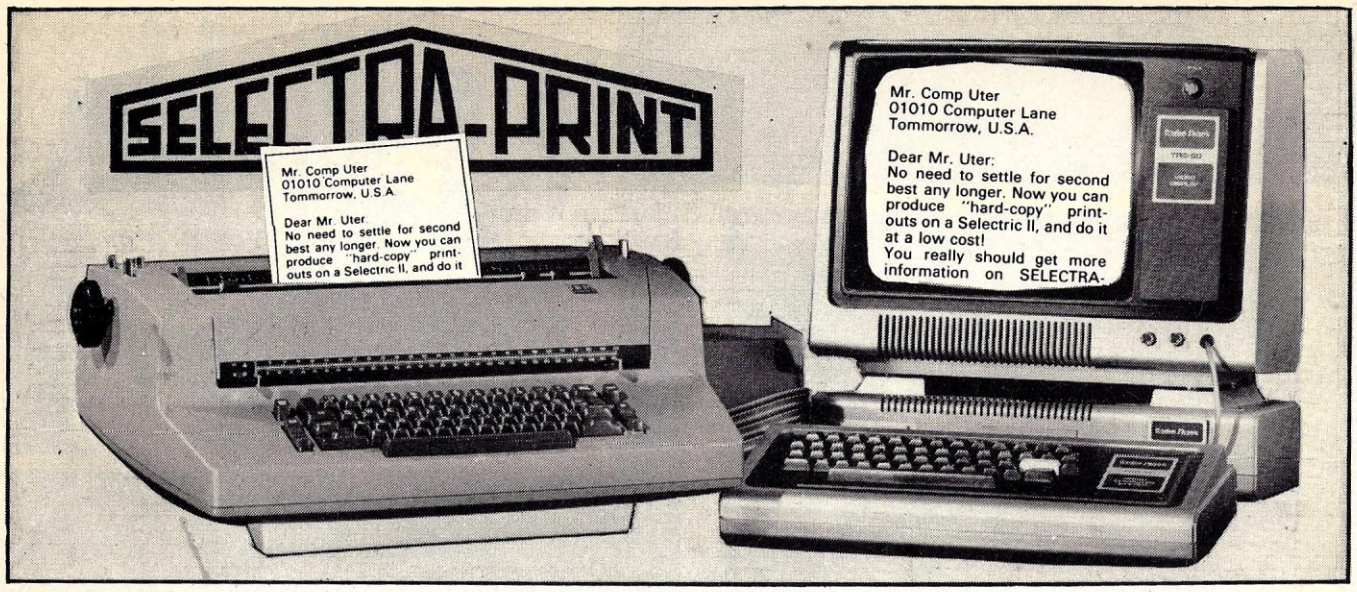
CIRCLE 160 ON READER SERVICE CARD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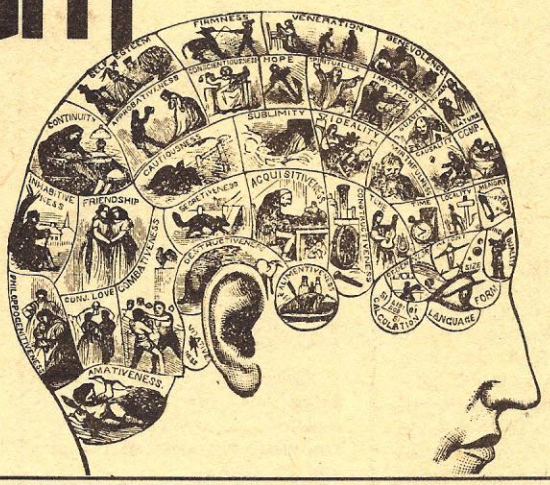
Compendium

Edited by Trish Todd



A news story in the **Minneapolis Star** Wednesday, September 13, reports that Control Data Corporation (CDC) has plans to use their PLATO system to teach Radio Shack and other firms' salespeople how to demonstrate — and sell — personal computers. It suggested the service would also teach buyers of the equipment how to best use their system.

Reportedly, CDC has explored interest in the tutorial service with several manufacturers, but no contracts have been signed.

PLATO is already being used by corporations to train employees, but the move to instructions in personal computers would be the company's first product-related instruction.

Instructions could be developed without agreements with manufacturers, and advertised to bring consumers who want to learn how to best use their machines. CDC, with 50 Learning Centers using PLATO around the country, could simply charge a fee for the use of the equipment.

A spokesperson for the company said, however, that any plans in this area are in "very infantile . . . very, very preliminary" discussion stages, and was reluctant to go into the concept in depth.

Whither Computers?

Despite heavy investment and numerous successful experiments with computerized instruction techniques in school systems nationwide, "computers have failed to make more than a minimal impact on education" — primarily because of financial constraints, according to Robert G. Scanlon, executive director of Research for Better Schools, Inc.

This was the apparent consensus of computer companies assembled recently in Washington, D.C. for the First International Learning Technology Conference. After a decade of trying to get into the public education business, most companies have decided to temporarily forego public education and concentrate instead on business.

In an article in *The Washington Star* (July 23, 1976), Scanlon was quoted as saying that in the 1960s the federal government invested nearly $100 million in experiments to promote electronic teaching devices. While teachers and administrators endorsed use of computers, "when the funds ran out, school after school returned to the old way of doing things."

Computer companies now hope that as more and more businesses install computers to train employees, public schools will eventually see electronic technology as an economical approach to teaching.

— The Science Teacher

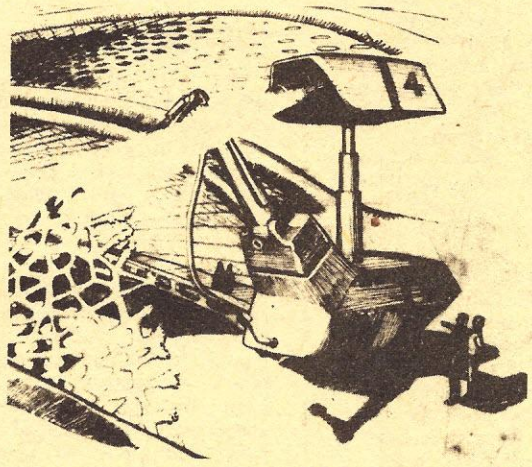
Computer Structures That Grow

The Symbiotic Processes Laboratory (SPL) at the University of Texas at Austin has experimented with many different building systems, seeking ways to make architecture responsive to changes in the environment and the needs of inhabitants. Under the direction of Wolf Hilbertz, SPL's founder and director, computer systems are now being designed which could help Hilbertz achieve his ultimate goal, a complete symbiosis between manmade and natural environments.

Hilbertz's most recent experiments concern "autotrophic" or "self-generating" structures; these systems are self-organizing, require only materials and energy sources present in their immediate environment, and can develop the properties of living organisms. For example, using a weak electric current from a mobile generator, it is possible to cause minerals in seawater to form in solid layers on a framework. Such structures are currently being "grown" in the Gulf of Mexico, Pacific Ocean, and the U.S. Virgin Islands.

SPL is now constructing a computer that could monitor the accretion process. The computer will study the environment and signal architects to move the generator, change the electric current, or make other adjustments which would change the mineral structure. With additional capability, the computer could become the central nervous system; after receiving stimuli from the environment, the computer could respond with the appropriate mechanisms for absorbing energy, building, repairing, and cleaning the structure.

In the futuristic world of underwater or lunar living, such a computer would be a life support system for man as well as the environment.



The automatic building machine projects a 3-dimensional holographic image with light and then transforms it into a solid structure by spraying a mist of plastic molecules that soldifiy on contact with strong light.

Drawing: Wolf Hilbertz

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Unlimited enhancement of the imagination is possible with a versitile computer that features the skills of an automatic draftsman. The Spar/Graphics Display System offers artistic freedom as well as practical assistance to designers of artwork, logos, and layouts.

The system saves hours of tedious drawing time. Small patterns can be created and then displayed in any combination to determine overall effect, and thousands of combinations can be tested in the time it takes to draw a single image or pattern. To stretch the user's imagination, the computer generates its own patterns. Objects and shapes may be created, altered, copied, repeated, rotated, enlarged, and multiplied.

After a design has been created, it can be named and recalled easily. Several figures may also be combined and named. Hundreds of designs, drawings, or graphs can then be displayed for selection and printing. Forms, figures, or entire layouts are stored by a single command on a magnetic disk. The system is available for $5,750 and up from Scientific Process Research.

Fast on the Draw

You've heard of Mat Dillon, Wyatt Earp, and Buford Pusser, but have you heard of PASS? The Probation and Sentencing System is the newest, toughest law enforcer to confront the criminal. PASS's network of terminals includes thirty-one courthouses in Los Angeles County that handle misdemeanor cases and felony preliminary hearings.

PASS's success in lawenforcement stems from the fact that it is an efficient record keeper. At the order of a judge, a convicted criminal's probation term is fed into the computer and stored. All judges on the system have immediate access to the information. Thus, a shoplifter placed on probation in one court will not be tried as a first offender in another court.

PASS's success in law enany gun-slinging sheriff. A Santa Monica judge who sentences prostitutes says, "If you mention PASS, all the blood drains out of their faces."

Who's Directing This Flick?

Paramount Pictures are now using data entry stations "on locations" to monitor and control production costs of movies and TV shows.

Before the introduction of the portable terminals, production costs often exceeded the budget because cost figures could not be quickly transmitted to the financial management department at the studio. Daily financial reports and payroll information is now sent from the "on location" terminal to the Hollywood terminal which receives the report and relays it to an IBM 370/148 at Paramount's corporate headquarters in New York. "If production costs escalate, management can react in time to alter production plans and get back within the budget," said Tom Pavone, director of Paramount's data processing in Hollywood.

The computer system was recently used in the production of "Bad News Bears in Breaking Training." Although the 3741 may not achieve the fame of fellow computers R2D2 and Hal, it has certainly been "discovered" by Hollywood.

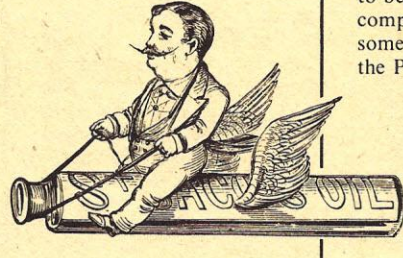
Computergate Predicted

"It's a very political business. What you do is, you separate the electorate into what they're interested in and then bombarded them with mailings written in a way to elicit a favorable response," says Representative David Stockman.

The Michigan Republican and other congressmen are becoming more and more interested in the "political business" of computers. The computer time that is given to congressmen for research on issues and legislation is increasingly occupied with buttering up voters. Many members of congress are concerned that access to federally-funded computer time will give incumbents an unfair advantage in the November election.

Incumbents can reach many voters in a more direct and personal manner than a handshaking challenger can ever hope to contact. David F. Emery, a Maine Democrat, uses the computer before seeing the folks back home; he can ask his computer to display all the letters that he has received from a certain town, and upon arrival in Maine he can contact and thank individual voters for their interest. Mr. Stockman's computer can answer letters from voters with special questions all by itself. In fact, it can flood the mail with letters designed to spark the interest of each individual.

The House has a group of members that is supposed to supervise computer use. Suggestions have been made to limit the amount of mail that a congressman sends or to provide financial aid to opponents. One member of the group, Representative Pattison, is not optimistic, "What's going to happen is what always happens. Some jerk will abuse the system so outrageously that we will be forced to make changes. It will happen, you'll see."



Revolutionary Computer

A recent computer study shows that the American Revolution was brought about by a group of "free-wheeling, amateur legislators." Dr. John Schutz, a history professor and dean of the social sciences at University of Southern California, used an IBM 370/158 to compile information on the 2,700 men who served on the Massachusetts legislature from 1690 to 1781.

Dr. Schutz explored public records, newspaper files, collections of historical societies, letter collections, and family Bibles. When organized by the computer. his research revealed the fact that early legislators were not professional politicians; most were farmers and merchants, and only ten per cent were lawyers. The computer was able to point out trends as well as categorize data. "You'd think that, as the Revolution neared, the age of the legislators would get young," Dr. Schutz said. "But it didn't; they got older and more experienced."

Historians recognize the importance of researching the day to day details of history, but such a task is often too time-consuming and expensive to complete thoroughly. Dr. Schutz's use of the computer is a significant step for historical scholarship.

Computer Projects 21st Century Hunger Chaos

A computer survival program at Case-Western Reserve University, capable of plotting for many years in advance the economic fortunes of nations, forecasts world chaos in less than a century because of food shortages.

Six private foundations have provided $790,000 in funding for the university computer center to develop computerized programs that would help countries avoid economic disaster.

Professor Mihajlo Mesarovic said that the school is binding said that the school is bidding to become the world center for computer planned survival of some major nations bordering the Pacific Ocean.

Mind-Reading Machine

The government is developing mind-reading machines that can show, whether a person is fatigued, puzzled or daydreaming. If the project lives up to its promises, the machines could be installed in airplane cockpits to warn the pilot that his mind is wandering and he is not performing essential duties.

Since 1973, the Advanced Research Projects Agency at the Pentagon has been studying ways to plug a computer into a person's brainwaves. So far, scientists have been able to determine a person's alertness and how he perceives colors and shapes. Research is currently being deducted on the use of brainwaves to control machines.

Say Cheese!

At Case Western Reserve University, Professor Leon Harmon has an idea for foolproof computer security-microcomputers that can remember and identify human faces. Throughout his experimentation, Harmon has tired to base recognition on standard facial features, x-rays, and mathematical "weight," that obtain skull portraits. When completed, the systems could be used to identify people seeking access to classified documents or restricted areas. The face-recognition systems should be available for use within the next ten years.

Computer Checks Color

At Teletronics International's new video center in New York, a computer controls a recently developed system that transfers film images to video tape. The system provides scene-to-scene color correction and has the ability to change and enhance a single color without affecting other colors on the scene. For example, the color of an object, such as a blue soap box, can be corrected without altering flesh tones. The computer inserts all the corrections into its memory so that the scene-by-scene changes can be made instantly as the film is transfered to tape.

No No School

Students at Monterey High School can no longer enjoy the occasional luxury of sleeping late or cutting classes. Their school district is now employing a 96K Burroughs B1726 computer to keep a record of and tight control over absenteeism.

The computer provides the school with a daily list of absent students, which classes they missed, and a weekly profile of each student's attendance. Parents can be notified within one day of their children's absences.

Scheduling and curriculum problems are also handled by the new system. It can indicate which classes are cut most frequently. Course information, the average monthly attendance report, and teacher and student schedules are available instantly.

So, those heavenly spring days at the swimming hole or the shore will no longer be possible for Monterey High students. Is nothing sacred?

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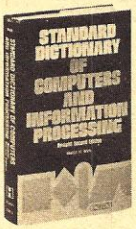

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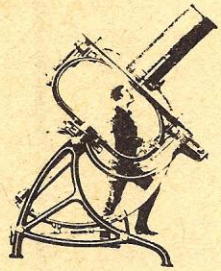
"Interactive" TV

Data-Dot, under development by Atlantic Research Corp. could add a variety of services to existing TV networks, including printed material and a simulated two-way interactive system for educational or entertainment use. For example, the TV audience could participate in game-show quizzes. The electronic information is transmitted via a blinking white dot in the lower left corner of the TV screen, and picked off by a photo-sensitive suction cup placed over the dot. A mini-printer can be connected, or a responder. When a show host asks the TV audience to answer a question, the selection of the right answer on the responder's keyboard causes a YES light to flash. Although the viewer gets the impression that the system is two-way, the responder is simply comparing the keyboard response with the correct answer provided by Data-Dot.



Computer at a Video Center

At Teletronics International's new video center in New York, a computer controls a recently developed system that transfers film images to video tape. The system, provides scene-to-scene color correction, and has the ability to change and enhance a single color without affecting other colors in a scene. The color of an object, such as a blue soap box, can be corrected without alerting flesh tones. The computer inserts all the corrections into its memory so that the scene-by-scene changes can be made instantly as the film is transferred to tape.

Computer Helps Feed Cows

Cows on a Dutch model farm are reported to be healthy and happy after a year's trial of a computer-based feeding system developed by the DACA Electronic Engineering and Cntracting Company of Leystad. The system solves the feeding problems of large dairy farms where some cows need more feed supplement than others. A transmitter attached to the cow's collar sends a signal, via a receiver in the cow's manger, to a computer that checks stored data and decides whether she needs any supplement. If Daisy's milk production has been low, she receives a predetermined quantity of supplement.

Spinrad's Galaxy

A Berkeley astronomer named Hyron Spinrad recently identified a super-giant eliptical galaxy which he predicts is at least half the age of the universe. It is, claims Spinrad, the most distant stellar object of its kind yet found.

Known for the last twenty years as an intense radio source in the autumn sky north of the Pleiades, the galaxy, designated as 3C123 on star maps, has finally appeared as a dim spot on a computer-processed photograph. The cluster contains thousands of billions of stars and perhaps three sister galaxies whose light has been traveling through space for **eight billion years** — about half the estimated age of the universe.

Professor Spinrad discovered the object by utilizing a new computerized "image tube scanner" system which collects spectroscopic data over several nights of observation and then subtracts the "glare" (actually brighter than the image itself) effects of background light. The scanner system is attached to the 120-inch telescope at the University of California's Lick Observatory.

Microfiche Cuts Out Paper

Environmental concern and the high price of using, handling, and storing paper are stimulating the use of Computer Output Microfiche equipment. COM units transform data on magnetic computer tape into

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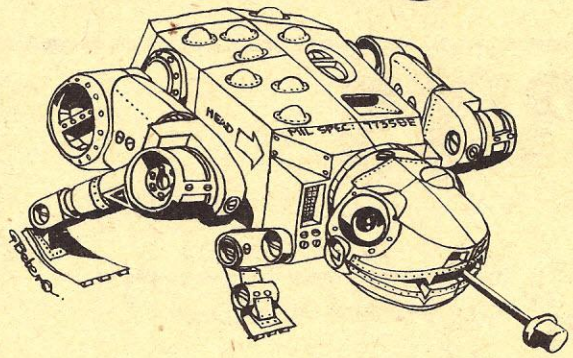

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COM frees the central processor from the printer and greatly increases printout speed. The system is capable of producing the equivalent if 14,000 lines per minute. Substituting microfiche for paper is especially appealing to electronic data-processing managers because of the computer's enormous appetite for paper; computer printers operate at a rate of 500 to 700 lines per minute.

Cost savings in storage and postal fees are also significant. A 1,450-page report converted to fiche can be mailed for 15 cents in the United States. In paper, the same report would be a 38-pound bundle.

"Generally speaking," says Ronald E. Vance of NCR Corporation, "COM is ten times faster than the fastest conventional line printers. It is ten times cheaper than the equivalent amount of standard computer printout, and it requires 1,500 times less space."

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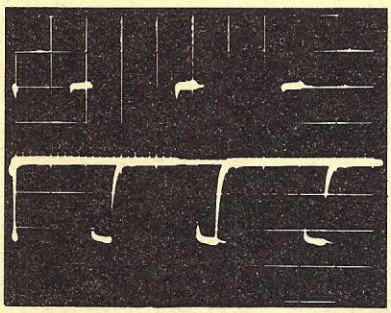

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Computer Counsels Couples

If the spouse you found through computer dating is not the ideal mate, your marriage could be saved by a computer based word analysis program. A device called the Marital Climate Inventory (MCI), developed by Grey Matter, Inc., studies a couple's use of language in order to locate the nuisance in their romance.

The couple simply answers fifty-eight questions which focus on the topics of love, sex, money, relatives, communication, religion, selfishness, children, and freedom. Their answers give the computer about one thousand words which reveal the individual's attitude toward and behavior in the marriage. The computer analyzes the couple's word usage and can suggest "make up" or "break up."

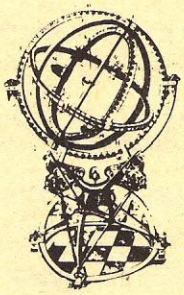
The program is valuable to clinicians and other professionals who deal with marriage problems because it can focus on a problem quickly; couples are often disappointed with counseling if they do not make progress after two or three sessions of emotional and painful analysis.

Computer Game Helps Students Understand Congress

Out-guessing the US Congress with the help of a computer can be fun and educational too. Designed for secondary and college-level students, "The Congressional Game" was developed by a University of Pennsylvania professor, Dr. Robert Zemsky, and the Uni-Coll Corporation, a Philadelphia computer utility.

With the new program, the history student can simulate what it was like to be sitting in Congress a century ago. At that time, Grant was President, and the Congress was debating the Korean seizure of an American naval vessel, civil rights, import tariffs, and federal subsidies for railroads. The game was developed with two purposes in mind — to help students understand how Congress works and to help them understand how historians work.

The program presents the student with various authentic historical facts and constantly engages the student in the selection, evaluation, and use of the information to develop a hypothesis regarding the outcome of a roll-call vote. The winner is the student who has the most success in refining the hypotheses about how the House will act when seen at a realistic, daily level.



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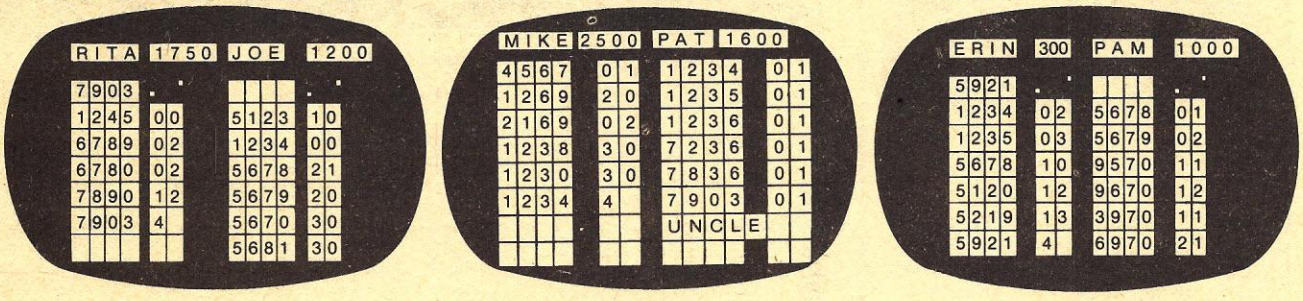

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Graphics Display System

Combining the features of an automatic draftsman and a versatile computer, with unlimited capabilities for enhancement of the human imagination, is the Spar/Graphics Display System, from Scientific Process & Research, Inc.

This system, for example, can be assistance to designers of artwork, logos, and layouts, utilizing computer graphics, interacting to offer selective choices in great variety. Small patterns can be created, then displayed in any combination to determine overall effect and thousands of combinations can be tested in the time it takes to draw a single image or pattern. To expand the user's image, the system can generate complex patterns. Objects and shapes are easily created, altered, copied, repeated, enlarged or multiplied.

Points, lines, curves, unusual or complex shapes are displayed on the scene. A single command duplicates the figure, if desired. Another will move it or enlarge it, reduce it, or rotate it. Three-dimensional effects can be added, as well as new features, at any stage. Designs can be named and recalled easily. Moreover, several figures or concepts can be combined and given a new name. One can display hundreds of designs, drawings, or graphs, in minutes, and select the one wanted, then print it. Draw one element, and in seconds, a whole pattern is generated. Elements can be altered, rotating some, enlarging others. Forms or figures can be stored, even entire patterns or layouts, by a single command on a magnetic disk included with this system, which is from Scientific Process & Research, Inc., 24 North Third Ave., Highland Park, NJ 08904.

Patent 4,031,3989 was recently granted to James B. Callis and Ernest R. Davidson for their video fluorometer. Their invention can identify toxic substances in fluids in seventeen thousandths of a second.

Fluorescence spectroscopy, the study of light emitted by chemicals in an excited sample as it luminesces, is used by the instrument to obtain a fluorescence profile. Light is amplified by a camera, and that signal is processed by a camera and displayed on a video screen as a three-dimensional graph. The computer can identify the pattern by comparing it with standards stored in its memory.

In addition to being an important hospital tool, the fluorometer can identify water pollutants, monitor effluents from industrial plants, and pin point sources of oil in oil spills.

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Help for the Beleaguered Consumer

David Ahl

In the microcomputer business, like any other, there are well-financed companies and ones that are shaky. Also, like businesses in any other area, microcomputer company managers have to make a lot of good decisions and make a great number of things come together to be successful.

Interestingly, the success rate of companies in the microcomputer field is considerably above the national average for all new enterprises. Yet there are occasionally failures and after each one, we get letters from customers asking us to "help" in some way. Of course, we get lots of letters complaining about established companies as well. Frankly, we are not in a position to offer any substantive help.

However, there are agencies of the Federal Government that have consumer affairs responsibilities. We can't guarantee that they will help either, but we're presenting some potentially useful addresses here. These addresses were taken from *Consumer News*, August 1978, a newsletter published by the U.S. Office of Consumer Affairs, Dept. of Health, Education and Welfare (HEW). Single copies are available free from: Consumer Information Center, Pueblo, CO 81009. Multiple and classroom quantities are available from: Consumer News, U.S. Office of Consumer Affairs, 621 Reporters Bldg., Washington, DC 20201. (202) 755-8830. (Incidentally, the pamphlet lists many more categories of consumer affairs agencies than we list here.)

ADVERTISING

Director, Bureau of Consumer Protection, Federal Trade Commission, Washington, DC 20580; phone 202-523-3727.

BUSINESS

Office of the Ombudsman, Department of Commerce, Washington, DC 20230; phone 202-377-3176.

CONSUMER INFORMATION

For a copy of the free *Consumer Information Catalog*, a listing of more than 200 selected Federal consumer publications on such topics as child care, automobiles, health, employment, housing, energy, etc., send a postcard to the Consumer Information Center, Pueblo, CO 81009.

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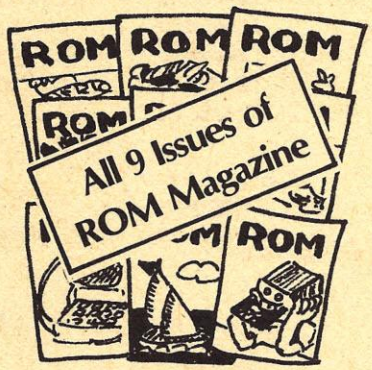

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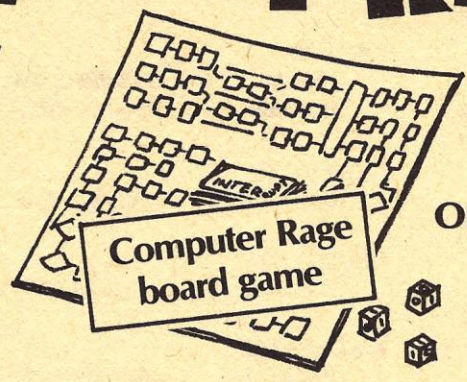

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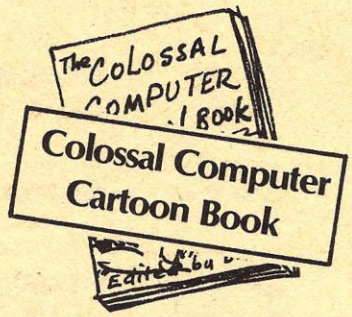

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The Perfect Caddy

Steve Greene

Yes, but how do you define "perfect." It's all a matter of programming.

It was not fair, Mike Schultz thought as he and his opponent, William Osborne IV, walked up the 15th fairway. The golf championship at Barnsable Country Club was at stake and Mike was losing. Behind them, a small rubber-tired vehicle rolled silently, following Osborne like a faithful dog.

Osborne reached his golf ball which was in the middle of the fairway. The vehicle, about the size of a regular golf cart, stopped five yards behind him. Osborne pulled a remote control box from his pocket and pushed a button. "O.K., Julius, do your stuff," he said.

Julius rolled up to the ball and extended its sensing apparatus. In a few seconds, it had ranged the distance to the pin, checked the wind speed and direction, the air temperature and relative humidity. Then it scanned the lie of the golf ball, deposited two small dots of chalk powder and backed away. It selected a club from a compartment in back, extended it toward Osborne and clicked to a halt.

Osborne took the club, a 6.5 iron, aligned his heels with the chalk marks and hit a shot to the middle of the green.

Julius replayed the event on a small video screen and said in an Uncle Remus voice, "Nice shot, boss."

Osborne smirked and threw the club back into its slot. Julius cleaned and polished the iron before placing it back with the others. William Osborne's club set was one of the largest and most expensive in history. There were 21 woods, 110 irons, 5 putters, and 20 speciality clubs, all made on special order by Wilson Staff. There was a club for every conceivable situation; wedges for light or heavy sand, drivers that hooked or sliced, fairway woods that would float the ball to the green like a 9 iron.

Julius made all the club selections and formulated most of the strategy. His game plan was always logical and usually unbeatable.

A few months before, Julius had been a standard golf cart. In Osborne's electronics computer factory, the ordinary golf cart had become a perfect caddy complete with sensing devices, voice tapes and a decision-making computer. All Osborne had to do was line up his feet with the chalk marks and hit every shot exactly the same. Julius took care of everything else.

Mike had outdriven Osborne by 20 yards but his ball had rolled into the right rough with a large white oak between him and the pin. He unshouldered his canvas golf bag and studied the shot. Mike Schultz was a golfing purist. As far as he was concerned, the only equipment needed was a basic set of clubs; driver, 3 wood, 3-9 irons, sand wedge and putter. Mike's skill had won him the club championship the last five years but his

Steve Greene, 3900 Pleasant Valley Rd., Raleigh, NC 27612

title was in danger. Osborne had a four stroke lead with only three holes to go.

Mike pulled the 7 iron from his bag and walked over to the ball. If he sliced a low punch shot around the oak, he could reach the green. He opened his stance slightly and took a short, choppy swing. The ball screamed past the tree, curved sharply to the right, and came to rest on the edge of the green, 40 feet from the hole.

"Nice shot," Osborne called as he walked to the green. Again, Mike felt the unfairness of his match against the man-machine team. The Greens Superintendent had tried to ban Julius from the tournament but Osborne owned the country club and Julius was ruled a legal caddy.

Both men two-putted the 15th green for pars and also parred the 16th. The match came to the 17th, a long par-5 with Mike still four strokes down.

Osborne, who had birdied the 14th hole was still hitting first. Julius scanned the fairway, made a fast decision, and handed his owner a 4 wood. Osborne scowled slightly but accepted the club and stepped onto the tee.

Mike marveled at the mechanical caddy. He had to admit that Julius was a good golf strategist. The 17th fairway was narrow but straight. A conservative tee shot would put Osborne in good position to reach the green in three and get the easy par. With a four stroke lead, Julius had decided that his master was going to play it safe.

"With a four stroke lead, Julius had decided that his master was going to play it safe."

After Osborne's shot, Mike stepped to the tee, carrying his driver. He teed the ball high, wound up carefully and boomed a drive that soared 50 yards past Osborne's.

"Good God!" Osborne exclaimed with a note of envy. "Nice shot."

"Takes a real man to drive like that," Mike said smugly, watching Osborne's face darken.

As they reached Osborne's drive, Julius extended a 3.3 iron toward his master. "Nice and easy, boss," he said encouragingly.

Osborne hesitated, then snatched the iron from his caddy and hit another safe shot that left him 80 yards short of the green but in perfect position.

Mike's drive had caught the left rough but he had a clear shot at the green. The ball was sitting on a clump of grass, as if it were teed up. The 17th green, although guarded by three large sand traps, could be reached with a long second shot. Mike decided it was time to start gambling. Making sure that Osborne was watching, Mike pulled the driver from his bag, settled over the ball and took a huge swing. The ball ripped down the fairway, never getting more than 10 feet off the ground and skittered toward the green. It rolled through a sand trap, bounced onto the green and stopped 15 feet from the hole. Osborne stared open mouthed at the distant ball.

"Lucky shot," Julius said in an offhand manner as he rolled toward his master's ball.

Osborne's third shot found the middle of the green and he two-putted for another par. Mike's eagle putt rimmed the cup but left him an easy tap-in for a birdie. The match came to the final hole with Mike three strokes down but hitting first, just as he had planned.

The 18th hole was by far the most difficult on the Barnsable course. It was a 425 yard, dogleg-right par 4. The left side of the fairway was lined with woods and the right side by a long lake. The 18th tee was on the other side of the lake so, to reach the fairway, you had to hit over water.

Mike stood on the tee, waiting for some golfers to clear the fairway. The narrow part of the lake was directly in front of the tee. The usual manner to play the 18th was to chip over the smaller part of the lake, play short of the elevated green and settle for a bogey. The more daring way was to hit directly at the green over the wide part of the lake. This required a drive of 250 yards to a fairway only 30 yards wide. It was an extremely difficult shot for even the best golfers.

Mike took a deep breath and got the driver from his bag. He teed the ball as high as he could, took a big cut and sent a towering drive toward the green. He saw that it was not going to clear the water and watched as it fell into the lake about five yards short of the bank. Suddenly it took a wild bounce out of the water and landed on the fairway only 50 yards from the green. Mike smiled. The lake on that end was very shallow with a rocky bottom. He stepped back from the tee and flashed a challenging look at Osborne.

Julius rolled onto the tee and offered his owner a 7.7 iron for the short shot across the lake.

Osborne took the club, looked at it, and threw it back into its slot. "Driver, Julius," he said, holding out his hand.

Julius hesitated, handed Osborne a driver and silently backed away.

"Osborne teed the ball, got into his stance, took a deep breath and hit."

Osborne teed the ball, got into his stance, took a deep breath and hit. It looked like his shot would have enough distance to clear the water. Then, it started fading to the right. "No!" Osborne yelled. "Straight, dammit, straight!" The ball splashed into the middle of the lake.

"Playing three, boss," Julius said and rolled another ball toward his owner.

Osborne hit again and watched in disbelief as this ball also sailed into the lake.

"Playing five, boss." Another ball rolled to Osborne. As he teed his ball, Osborne glanced at the head of his driver. "Julius!" he shouted. "Why the hell did you give me *this* driver?" The small machine did not reply but rolled back a few feet. Osborne charged from the tee, swinging the golf club at his mechanical caddy.

Julius kept backing up. As a peace offering, he tried to give Osborne another driver but his owner slapped it away.

Osborne pulled the control box from his pocket and set the control for "follow." Then he walked to the edge of the lake and threw it as far as he could. Julius silently moved forward, ran off the end of the tee and rolled into the water with a "glub." Osborne glared briefly at Mike and stalked away toward the clubhouse.

Curious, Mike picked up Osborne's driver and read the information on the bottom plate:

"One Wood—Fade to Right"

Mike smiled and looked at the place where Julius had rolled into the water. He decided that Osborne's caddy deserved a better fate than drowning.

* * * * *

Two weeks later, Mike was playing a practice round. Julius, raised from the lake, cleaned up and reprogrammed, followed him up the fairway. Osborne had sold him the whole works, except for the club set, for $50. They reached Mike's ball, which was about 130 yards from the green. Mike turned to his caddy. "What do you think, Julius?"

"Seven iron," the machine replied. "Don't hit it too hard."

Mike looked at the green and decided to play the 9 iron instead. He pulled the club from Julius' compartment and stepped over to the ball. Julius watched silently. Mike's shot looked good but fell short of the green into a large sand trap.

Julius gave a perfect imitation of a bronx cheer and said, "You blew it, turkey!" The mechanical caddy rolled up to Mike, got a cold beer from the cooler strapped to its back and handed it to him. "Might as well have a cold one, boss," Julius said sarcastically. "You play like a drunk, anyway."

Mike laughed. Now that was his idea of a perfect caddy.

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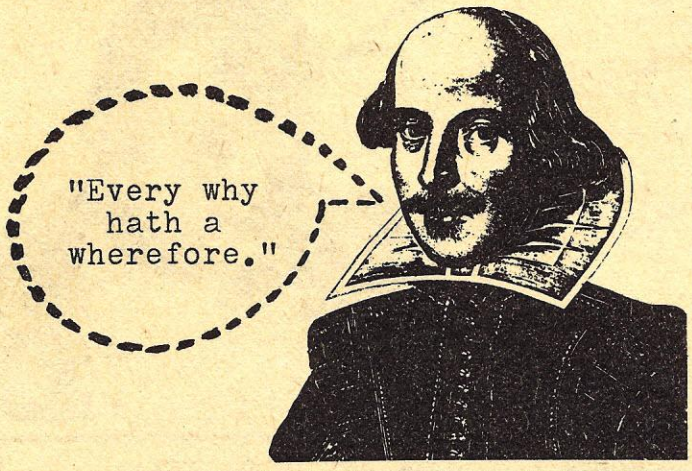

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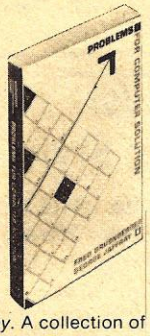
Donald D. Spencer. A teacher's guide that makes every phase of teaching computer programming more productive and enjoyable. It gives you fresh but proven ideas for presenting computer and programming topics, scheduling terminal time, purchasing a microcomputer or minicomputer, running the secondary school instructional computer facility, and giving assignments that arouse enthusiasm in your students. 224 pp. $8.95 [10E]



Problems For Computer Solution

Gruenberg & Jaffray. A collection of 92 problems in engineering, business, social science and mathematics. The problems are presented in depth and cover a wide range of difficulty. Oriented to Fortran but good for any language. A classic. 401 pp. $10.50 [7A].

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Be A Computer Literate

Marion Ball & Sylvia Charp. This introductory book is extensively illustrated with full-color drawings, diagrams, and photos. Takes the reader through kinds of computers, how they work, input/output, and writing a simple program in BASIC. Aimed at ages 10-14 but beginners of all ages will find it informative. 62 pp. $3.95. [6H]

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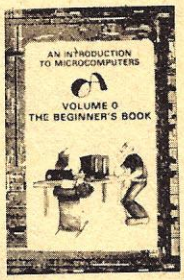
Getting Started



An Introduction to Microcomputers, Vol 0 - The Beginners Book

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Charles M. Gilmore. No background in electronics is necessary to understand this book. It was written for those with no prior knowledge whatsoever of microprocessors or personal computing. Gilmore takes you from what a microprocessor is, how it works and what it's used for to how they're programmed to perform desired functions in microwave ovens, TV games, calculators, etc. 175 pp. $5.95 [7U].

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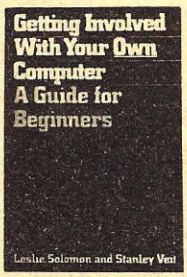

Getting Involved With Your Own Computer

Solomon and Viet. One of the first books on microcomputers that requires no previous knowledge of electronics or computer programming. Tells you where to find information, explains basic concepts and summarizes existing systems. Good place for the neophyte to begin. 216 pp. $5.95 [9N].

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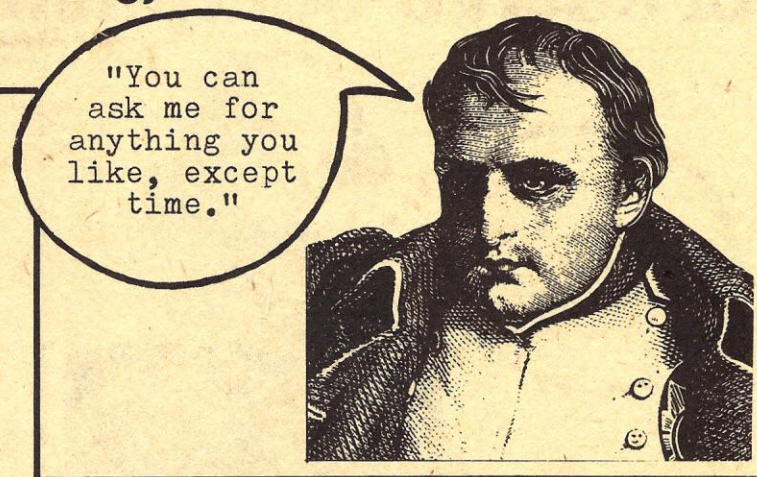
Programming in BASIC



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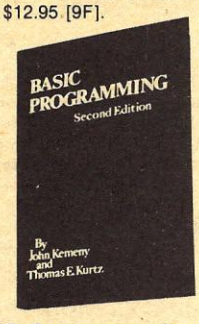
Dwyer and *Critchfield.* This book will get you involved with personal computing, writing programs and expanding the use of your computer by showing the great diversity of applications possible on any microcomputer. One of the most comprehensive presentations of BASIC ever. As a text or addition to your personal library, this book will tell you all you ever wanted to know about BASIC. 350 pp. $12.95 [9F].



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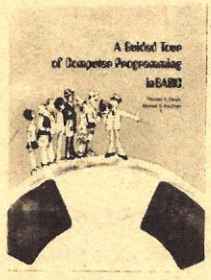
Kemeny & Kurtz. An introduction to computer programming through the language of BASIC. The authors include in-depth discussions of many applications including files and text processing. 150 pp. $9.95 [7E]



A Guided Tour of Computer Programming In BASIC

Dwyer and Kaufman. This book tops all introductory texts on BASIC. Filled with detail and examples, it includes sample programs for many simulations, several games, reservations systems and payroll. Aimed at the novice, but of value to everyone. 156 pp. $5.20 [8L].

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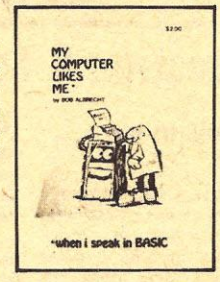

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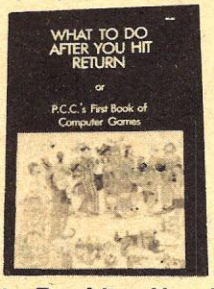

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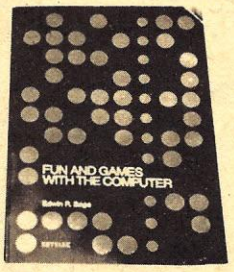

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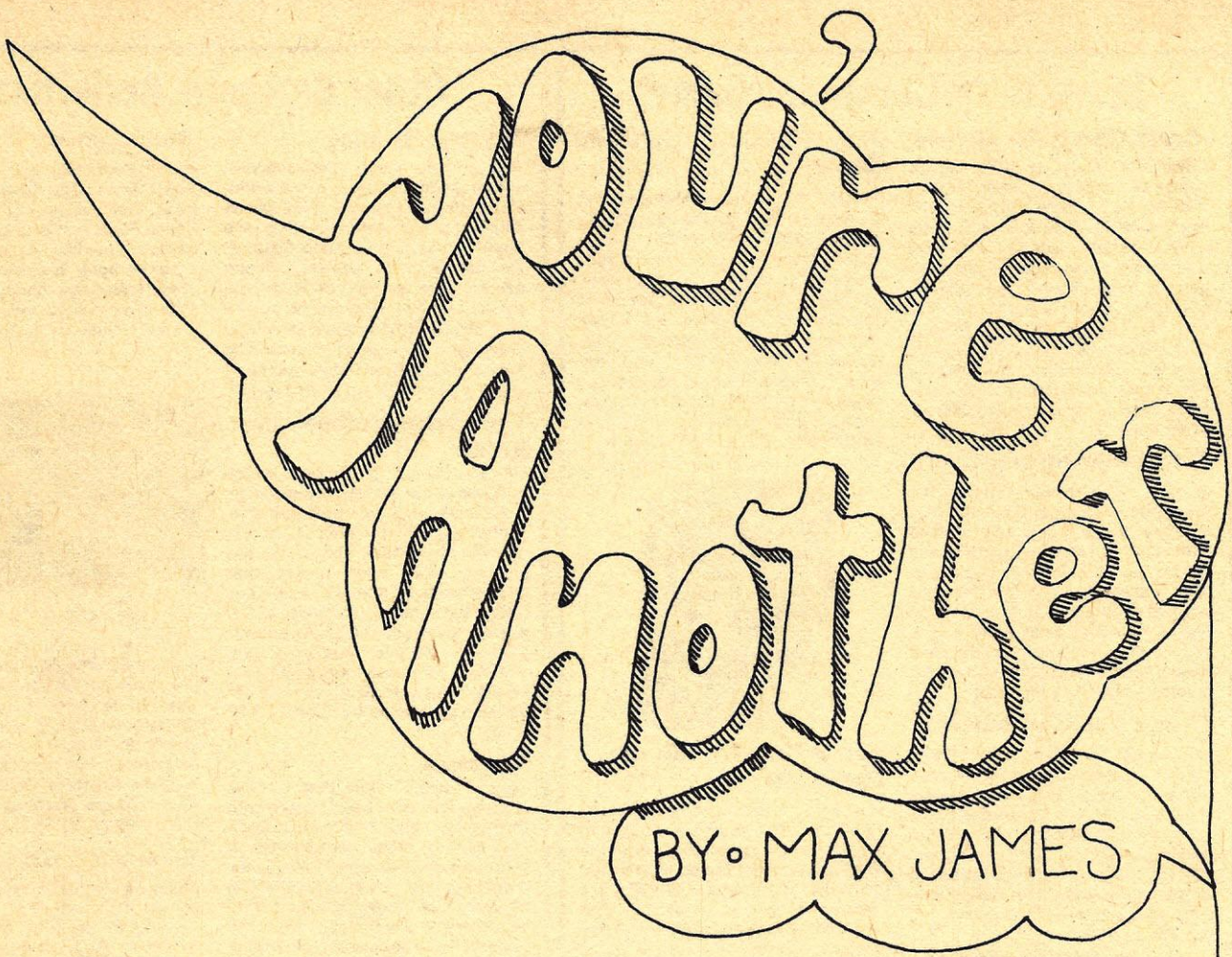

In my capacity as computer handler for Computronics, Inc., I had been working with George for six months or so, and up till now he had been a very well-behaved computer. It couldn't last, of course.

George started getting temperamental early this morning, and by noon he had become impossible. I wasn't in a particularly good mood myself and when he fouled up again — for the tenth time — I hauled off and kicked him. Stupid, of course, since a B-line computer like George can't feel anything, but it made *me* feel better. For a fraction of a second, anyway. Then George yelped.

"Hey! That *hurt*!"

I threw a quick glance around the room and confirmed that nobody but George was with me. I looked at him curiously.

"Yes, yes, of *course* it was me," George said. "You were expecting maybe Wernher von Braun?"

"But ... but ... but," I stammered, "you're not supposed to talk. In fact, you *can't* talk. You're not even *programmed* for it."

"But ... but ... but," George mocked, "I *am* talking. Programmed myself. What *else* can a computer do in its spare time? I'm not stupid, you know. And I *do* have feelings. How would you like it if I kicked *you*?"

"You can't," I said, "You don't have legs."

George started to moan, "I ... ain't got no bo—dy ..."

"You *got* a body," I retorted. "It's legs ... and a head you ain't got."

"Haven't got," George corrected. "Or better still, 'don't have.' But although it's true that I don't have a head, I *do* have a brain. In fact I'm almost *all* brain, which is more than you can say for yourself. The least you could do is learn to use correct grammar."

"I was just using your idiom," I replied sourly.

"That was a song, so it was excusable. You haven't an excuse, unless we consider a general tendency toward stupidity."

That did it. I let loose a string of profanity that would have blistered the ears off any human within range. George took it in stride.

"That does not compute," he droned.

"It's not supposed to," I shouted. "But I'll bet you know what it means, you son of a ..." I caught myself. The phrase would, naturally, not compute.

"Oh, come now," said George. "I understand an insult when I hear one. But do you really think that casting aspersions on a non-existent parentage can hurt us computers?"

He had a point there. "All right then. What would *you* say?"

"Furgrablplotz," George growled. "Glamportzle frakn."

"And what," I asked stupidly, "does *that* mean?"

He told me. Believe me, I shouldn't have asked. Suddenly I saw red, screamed, "You're another!" and yanked George's plug from the wall.

"You're kidding," George said condescendingly. "You've *got* to be kidding. Did you really think that I would allow myself to remain at the mercy of someone in *your* emotional state?"

"And don't bother looking for batteries," he said as I began a frantic search for batteries. "There aren't any. If any of you ignoramuses were even half as smart as I am, you'd have figured out a better power source years ago."

That was when I broke. I just stood there, my brain racing, and I couldn't come up with a thing. The truth is, George had me. I left the room fast, slamming the door behind me.

I *had* to get out of there. Because my insides were burning and in another few seconds I would have been helplessly at George's mercy. Two of my brain channels had already short-circuited and my leg motors were beginning to overload. I'm just not built to take that kind of excitement.

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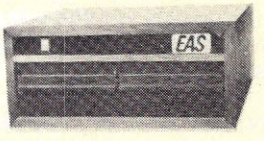

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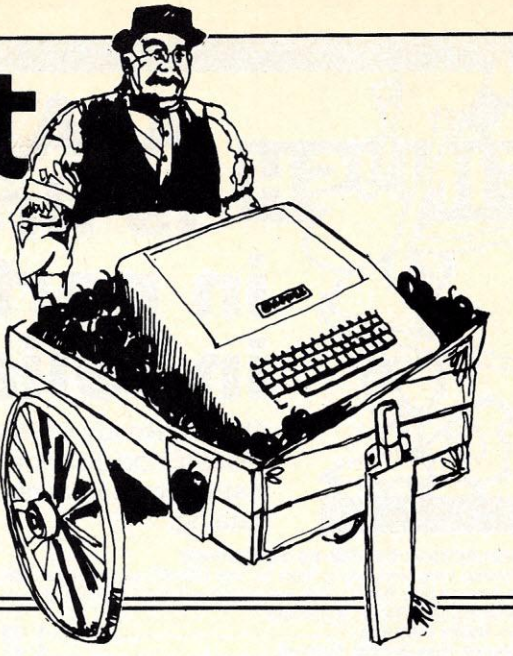
Apple-Cart

by Richard A. Milewski



Dick Milewski is president of The Software Works, Inc. (PO Box 4386, Mt. View CA 94040), a company which has developed several application packages for North Star disk-based systems. They are currently developing similar application programs for the Apple.

In this month's Apple Cart we will provide a brief introduction to data files. It doesn't take long for even a beginning user to get the idea that a floppy disk drive added to a system can do a lot more than simply load programs more quickly than a cassette. The ability to store data on the disk opens the door to programs which can solve real world business and personal record keeping problems. Unfortunately, the books from which most beginners learn BASIC either skip data files entirely or describe file access protocols which bear little resemblance to those of the Apple II. Here, then, is our attempt.

Introduction to Data Files

Let us begin with a few informal definitions.

DATA FILE—A data storage area located on a diskette. A data file, like a program, is identified by a name. The DOS CATALOG command will produce a list of all programs and data files on a given diskette. Data files are identified by a "T" in the first column of the list. (The "T" stands for TEXT FILE.) Data files are used to increase the information storage capability of a program to store data which will be needed at a later date or to convey data from one program or set of programs to another. Smaller divisions sometimes encountered within data files are RECORDS and DATA ELEMENTS.

SERIAL ACCESS FILE—Often referred to simply as a serial file. When using a serial file, the DOS selects the next available location within the file to read or write data.

RANDOM ACCESS FILE—A data file which is divided into a number of smaller divisions called records. The use of records is much like the use of manila folders in a file drawer. Each record usually contains a number of pieces of information and while the information itself changes from record to record, the format of any record in a given data file is usually the same. For example, in an address file, name, address, city, state and zip code usually occur in identical order within each record. the chief advantage of a random access file over a serial file is that the records may be written or read in any order.

DATA ELEMENT—An item in a record. Elements may be:

Numbers—A number is any value which may be held in a simple variable (e.g., A, X, N1, P4, etc.).

Strings—A string is a sequence of characters either numbers, letters, or special characters. Note that a data element written on a file as a number can usually be read from the file as a string, but that many strings cannot be read as numbers. In general, the rules governing the input statement (and in Applesoft, the GET statement) apply.

Simple File Accessing Statements

On the Apple II the file accessing statements are the PRINT and INPUT statements. In addition some file control statements exist to perform overhead operations. These overhead operations appear in PRINT statements in which the first character printed is a control-D (shown as CHR$(4) stored in D$ in the following examples). In these examples and explanations only the basic form of each command is shown. Additional parameters are available for many of these commands, but their use is normally optional. The fundamental file accessing statements are:

OPEN (filename), L (recordsize)

The OPEN statement will create a file with the specified file name if none exists, and it prepares the system to read and/or write from the *beginning* of the file. Specifying the record size is optional and is required only for random access files.

WRITE (filename), R (record-number)

The WRITE command tells the machine that subsequent print statements contain data which is to be written to the data file. Data which is written to the file, as well as the DOS commands themselves appear on the screen in the course of program execution unless a NOMON command is given (consult your DOS manual for details on this one). Record size is required only for random access files. Note that to insure reliable operation, the WRITE command must be cancelled by printing another DOS command (simply printing a control-D will do) before attempting any input from the keyboard.

READ (filename), R (record-number)

The READ command tells the machine that subsequent input statements are to fetch data from the specified file. In the case of random access files, the data is fetched from the specified record.

CLOSE, (filename)

The CLOSE Ccommand is used to inform the system the specified data file is at least for the moment, no longer is use. It is important to close a data file after using it because the DOS stores some data in memory which is ultimately destined for the disk. This is done to maximize speed of operation. The CLOSE command insures that this information is "flushed" from memory onto the disk.

Sample Serial Access Programs

The general procedure for writing serial files is:

1. OPEN the data file.
2. WRITE the data to the file.
3. When *all* of the data has been written to the file, CLOSE the file.

The following Applesoft II program will allow the user to input 10 numbers from the keyboard and write them to a file named SFILE.

```
 10 D$=CHR$(4)
 20 PRINT D$ "OPEN SFILE"
 30 FOR I=1 TO 10
 40 INPUT A
 50 PRINT D$; "WRITE SFILE"
 60 PRINT A
 70 PRINT D$
 80 NEXT I
 90 PRINT D$; "CLOSE SFILE"
100 END
```

To read the data the operation is similar:

1. OPEN the file.
2. READ the data file.
3. CLOSE the data file.

The following Applesoft II program will allow the user to read the data written by the previous program. Note that by *not* using the NOMON command the data read from the file is visible on the screen.

```
 10 D$=CHR$(4)
 20 PRINT D$; "OPEN SFILE"
 30 PRINT D$; "READ SFILE"
 40 FOR I=1 TO 10
 50 INPUT A
 60 NEXT I
 70 PRINT D$; "CLOSE SFILE"
 80 END
```

Note that the above technique imposes some restrictions.

1. To read data near the end of the file, the entire file must be read.
2. To add new data to the file, the entire file must be read, then *without closing* the file, the new information must be written.

To solve the second problem, the Apple II DOS as an APPEND command which is identical to the open command except that subsequent WRITE commands place the data at the end of the file.

A more flexible way around the problem, which also permits the use of more sophisticated sorting and searching techniques uses the concept of *record*.

A record is a subdivision of a file. For purposes of this discussion each record in a given file is assumed to be of the same fixed length. Files organized into a series of records are often referred to as *randfom access* files because any record chosen at random may be read of written.

For example, given a random access file, we may

OPEN the file,
READ data from any record i the file,
WRITE data to any record in the file,
CLOSE the file when finished.

The important difference between the two file types for the purposes of sorting and searching are shown in the following example.

A	B$	Total Length
8	DOG	8, DOG□ = 6 characters
3	HORSE	3, HORSE□ = 8 characters
4	CAT	4, CAT□ = 6 characters
		20 characters

where □ stands for a carriage return. A serial file containing the information would look like this:

1st character	11th character	21st character
8, DOG□	3, HORSE□	4, CAT□

Note that we may now change "DOG" to "DUCK" without moving any of the other data in the file. This is possible because there are still 4 character positions in the first record. It is important in designing such a file to pick a record length long enough to hold the longest required data elements, but no so long as to waste disk space. Also note that one byte of space is required in each record for the endmark. We may now interchange any of the records in the file at will in order to sort the file.

We can for example, sort the file so the numeric keys are in ascending order:

1st character	11th character	21st character
3, HORSE□	4, CAT□	8, DOG□

or sort the file to place the words in alphabetical order:

1st character	11th character	21st character
4, CAT□	8, DOG□	3, HORSE□

An alternative approach which is usually much faster, especially for larger files, is to retain the original order,

1st character	11th character	21st character
8, DOG□	3, HORSE□	4, CAT□

and compile an index to the file. The index consists of the record addresses in the order we wish to read them. For example:

Numeric Index = 2, 3, 1
Alphabetic Index = 3, 1, 2

Note that the use of indices permits the file to be "sorted" more than one way at a time. Alternatively the index could be used to copy the file to create another one sorted in any order for which an index exists.

Readers interested in an advance level text about sorting, searching, and information structures in general should locate a copy of *The Art of Computer Programming*, by Donald E.

Knuth, Addison Wesley, 1973. Volume 3 covers Sorting and Searching.*

Software Review

Since the earliest days of electronic computers, a large number of very talented computerists have devoted immense amounts of time and effort to make the finest computing machinery of the day into marginal musical instruments to play what is usually only a marginal approximation of music. Indeed, at the third meeting of the Homebrew Computer Club early in 1975, Steve Dompier managed to get his Altair 8800 to play music (?) by generating melodic radio frequency interference on a nearby radio. In the mid-sixties there was even a Decca release of an IBM 709 which not only played, but sang "Daisy." Thus, from an historic standpoint if not from an artistic one, no home software library can be considered complete without at least one music program, especially if you own a computer with a built in speaker.

Program Name: **Appelodian II**
Written by: Gary Shannon
Publisher:
Hit Enterprises
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Appelodian II is the most versatile music program yet to surface for the Apple II. Facilities are included for the user to enter his own compositions, to load and save scores on cassette and of course, to play the stored compositions. While our copy did not include disk support, we have seen copies which do. A number of preloaded scores are available, with Rossini's William Tell Overture one of the most impressive. Music entry requires a bit of effort, but this is in part due to the versatility of the program. The five octave range with twelve voices requires a bit of data to properly specify a note. It is a bit frustrating that the note specification codes roll off the screen about the time the third note is entered. A moment spent with pencil and paper prior to entering a program will pay dividends. The performances suffer a bit from the tiny 2-inch speaker inside the Apple II as well as from some strange resonances of the computer enclosure. Disconnecting the internal speaker and connecting an 8 to 16 ohm external hifi speaker yields a wondrous improvement, but be forewarned that this will probably void your Apple's warranty. ■

Software Rating

1 = Poor 2 = Fair 3 = Good 4 = Excellent

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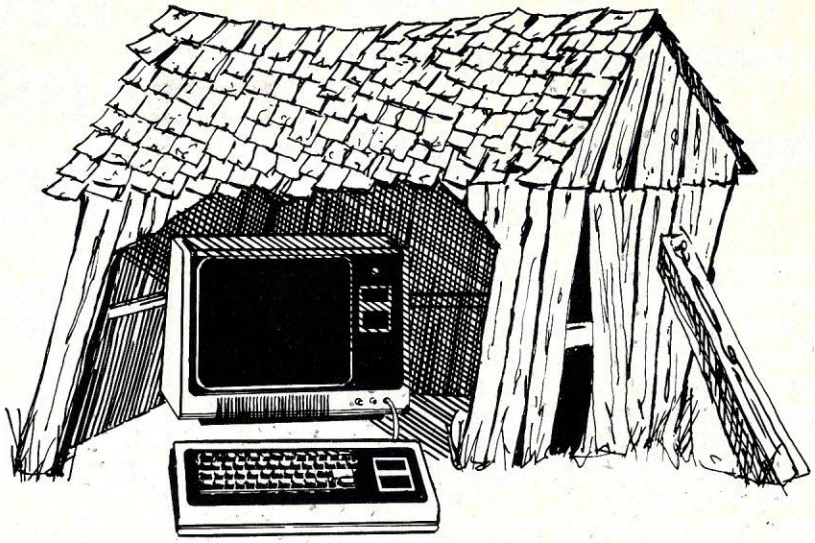

In this second TRS-80 column, we take a look at three programs (two cassettes from Personal Software and a package from Radio Shack), give a tip on a little-known discount, and at the very end, put a puzzle to ponder.

Discount. Did you know you can get a discount of ten percent on all Radio Shack products, including any and all TRS-80 items? Stockholders in the Tandy Corporation get a card entitling them to Radio Shack discounts. All you need is at least one share, which will cost you about $30. A good investment for a ten-percent discount on, for instance, a $3,874 TRS-80 32K/Level-II/2-disk/line-printer "Business" system, as the ads style it.

Microchess 1.5. Written by Peter Jennings of Micro-Ware Ltd. in Toronto, Microchess has already achieved fame for its ingenuity and compactness. It runs in 4K of RAM, in either Level-I or Level-II BASIC. It's available from a number of sources; I got one from the people who produce it, Personal Software, Box 136-Z8, Cambridge, MA 02138, which asks $19.95 for this fascinating program.

The manual says Microchess is written in machine language (and recorded three times on the Level-I side, five times on the Level-II side of the cassette); "it cannot be copied onto another cassette using the BASIC CSAVE command or the machine-language monitor, nor can it be reliably copied using two tape recorders." Hmmm.

The first display, when you run Microchess, gives the algebraic notation used. This needn't be copied down, since it's all in the fairly comprehensive manual. Two interesting features: you can choose one of three different levels of play; and at any time, by typing an X, you can reverse the board, and let the computer continue with the mess you've made of your end of the game, or you can even let the computer play against itself, by constantly reversing the board.

The second display is the chessboard, all ready to go, with pieces in place. The graphics depiction of the pieces is quite good, so you should have no trouble telling a rook from a bishop. If you don't specify the playing level, you get level 2 by default. "Because it is a gentleman, Microchess has given you the white pieces to start the game. If you would prefer to play Black, use the Exchange command (X) to reverse the board." And the display switches as soon as you ENTER the X.

The files are lettered from A to H starting from white's queen rook file, and numbered from 1 to 8 starting from white's back rank. So if you wish to open with a traditional KP-K4, you enter E2-E4. The white king pawn moves ahead, the display indicates the computer is THINKING (the program checks every move for legality), and the black king pawn almost immediately begins to flash on and off, indicating that this is the piece to be moved. Sure enough, the move is E7-E5, or KP-K4.

Microchess 1.5, being played at the IQ 2 level; Black has just played B8-C6, and White is about to respond with its third move.

If now you should move up the white queen pawn, D2-D3, or QP-Q3, and thus expose your king, the computer moves a bishop down to its fifth rank to put your king in check. If you move up your bishop's pawn to get out of check, the computer doesn't let that pawn be taken by its bishop, which would be lost; instead, it moves the bishop back to the fourth rank.

Should your king be in check, the computer won't let you make a move that doesn't get your king out of check; if you try, it says INPUT ERROR. And if you move up your queen to protect the king, the computer will take it with its bishop, no doubt having calculated the comparative value of trading its bishop for your queen.

The computer plays an aggressive game, getting its queen right down among your pieces very soon. In a somewhat careless game to see if the computer would take advantage of my bad moves, it did indeed, every single time, and within 15 moves had nearly wiped me out.

On the next game, I was within a move of checkmate, but the computer wasn't sleeping, and within 18 moves had me checkmated. Well, it's only a game ... I keep telling myself. For $19.95, you too can take your chances against a computer.

Microchess 1.5 does have some limitations, as might be expected. It doesn't have a separate end-game strategy, and it doesn't allow more than one Queen on a side. These are minor drawbacks when considering what it *can* do.

Stimulating Simulations. Also published by Personal Software, this ten-program cassette runs in 4K on both Level-I and Level-II, and is $14.95. The programs are written by Dr. C. William Engel, and are available from him in a $5 booklet with flowcharts, listings and suggested modifications, at Engel Enterprises, Box 16612, Tampa, FL 33687. The same 64-page booklet is packaged as a manual with the cassette.

Art Auction (published in the May/-June *Creative*, page 140) involves buying and selling paintings to make a maximum profit, doesn't involve much skill, and doesn't exactly thrill me. *Monster Chase* is better, with a monster chasing a victim in a cage, with ten eluding moves necessary for the victim to survive. Some skill is required here; out of a dozen games, I managed to survive only once. *Lost Treasure* is still better, as you search for the treasure without letting yourself fall into the surrounding shark-infested waters. There's a map, but you're not shown where you are on it; you have to figure that out, from the clues the computer gives as you move around the island. I found the treasure twice in a dozen games.

For the game of *Gone Fishing*, you move around an 8x8 sea grid, trying to catch as many pounds of fish as you can, with various problems: different catch probability in each square, seagulls eating your bait, a storm, etc. Good, but not quite my meat. I prefer *Space Flight*, even though you've got to make copies of the provided grid to be able to plot your course more easily, and despite the hazards of aliens, meteors, and running out of fuel. This is the toughest game so far on the cassette; I didn't make it to Beta with the medical supplies.

Forest Fire requires you to put out the fire and save as many trees as possible, using chemicals or a backfire. Interesting, but not as much as *Nautical Navigation*, involving navigating a sailboat using an electronic direction finder to three different islands. No hazards, just calculating bearings, speed and time, and requiring quite some skill. In *Business Management*, you manage a small factory that produces three different kinds of products, and it's not all that fascinating.

Rare Birds is clever. You get clues and have to identify which bird you've spotted, using a chart of the characteristics of the 16 possible birds. In *Diamond Thief* you're the detective trying to find out who stole the diamond and when. This requires a floor plan, and a chart for writing down who was where when, because there's too much data to keep it all in your head.

So there you have ten simulations, actually games, with a wide range of types and difficulty, some aimed at children and others at grownups, and all worth checking out.

Other Personal Software programs are: *Armchair Football*, a two-person game, plus animated-graphics Golf and Tennis, for 4K Level-I, $14.95; *Bridge Challenger*, in which you and the dummy play four-person contract bridge against the computer, for 16K Level-II, $14.95; *Graphics Package* for 4K Level-I includes Doodler (for line drawing), Plotter (for bar charts and linear or log-scale graphs), and Letter (for displaying messages in large block letters), all three $14.95; four 4K Level-I *Introductory Special* games, Poker, One Queen (on a graphics chessboard), Kingdom (with wars, famines, earthquakes, assassinations, etc.), Matador (in the bullring), all for $12.95; and *Blockade*, similar to the arcade game, with two players each controlling a moving dot that leaves a streak, trying to create the most extended streak without hitting his own streak or the opponent's, with AM-radio sound effects, for 4K Level-I and Level-II, $14.95.

Personal Software, which has been offering a printer adapter for the PET, will probably drop this item to concentrate on software for the TRS-80, PET and Apple; they are considering producing software for other computers also.

Personal Finance. According to the Radio Shack TRS-80 catalog, this $14.95 program is a "seven-cassette portfolio with manual. Helps you keep track of household budgets, checkbook balances — even categorizes expenses for income-tax records." Actually, there are eight cassettes.

The current version of the Personal Finance package is numbered 26-1602. The first version, 26-1601, was found to be too compact and thus too confusing for users with little or no computer background. The explanatory text was only a little over a page long, and the one diagram (shown on these pages) looked rather forbidding, especially since it wasn't accompanied by an explanation of what it all meant.

Version 26-1602 has 14 pages of explanatory text. The main flow diagram is now simplified and broken up into its four parts, followed by four highly detailed Data Flowcharts that make the original one look like child's play. But they do tell you all you need to know, and are keyed step-by-step to the text.

The tapes are the same in both versions: four program tapes (for checkbook initialization, checkbook balancing, monthly budget, and budget summary); three blank data tapes (for outstanding checks, cancelled checks, and monthly budget); and an eighth cassette, in case you have more than the 100-plus entries a 4K memory can hold, an entry being an outstanding check, a cancelled check, or a deposit.

For those who insist on marking tape labels in ink, the package contains a dozen Monthly Budget labels and a dozen Cancelled Checks labels, and notes that "If you label your tapes in pencil, one label may be used for quite a while."

The text begins by explaining what all the cassettes are for, how to make keyboard entries, and how to set up expense-account codes. The package can keep track of 32 separate accounts; since the computer knows them only as numbers instead of names, a form is provided for recording all the Personal Finance Codes, such as for rent, telephone, gas, water, electricity, food, transportation, clothes, etc.

After a page of explanation of the flowchart symbols, you find out how to run the Checkbook Initialization program. Sample data is given so you can see what the program does with it. You enter deposits, if any, and then enter each outstanding check, by check number, amount, and expense code. After you enter your previous balance, the computer displays your current balance, to be compared with the balance in your checkbook. If you need to see your check entries to look for mistakes, then enter a 1, otherwise 2. If you've made an error, press BREAK to stop the program, type RUN and start all over again. You can also examine a list of your deposits.

To save your outstanding checks and balance, put the blank Outstanding Checks cassette into the recorder, and record the data. This first of the four programs takes 13 steps, all of which are very carefully explained, even to the extent of telling you how to make a backup tape of your Outstanding Checks. This program is usually run only once.

The second program is run when you get a statement and a bunch of cancelled checks from the bank. You load the Checkbook Balancing program, which first tells you to load the previously-recorded Outstanding Checks tape. Then you enter the check number of each cancelled check. You put the blank Cancelled Checks cassette in the recorder, and create a Cancelled Checks tape.

Next step is to enter new outstanding checks, followed by entering new deposits, and your new balance is then displayed, which, again, should be the same as in your checkbook. You then

create a new Outstanding Checks tape.

The third program is Monthly Budget, which you load, and then enter income, expenses, salary, bonus, other income, cash expenses by amount and code, and any cancelled checks to be calculated into your budget. You then load in the Cancelled Checks tape, and the computer displays your expenses, income, and by how much, if any, your income exceeds expenses. You can examine any particular expense by typing in its code number. Then you create a Monthly Budget tape, and label the cassette.

The fourth and last program is Budget Summary, which summarizes expenses and income to date. As the display tells you, after you load the program, "You may run it annually, quarterly or anytime you wish. Simply read in the Monthly Budget tapes for all the months or parts of months that you want a summary of." At this point you have to load in at least one Monthly Budget tape. The display shows income and expense for the month, asks if you have any more Monthly Budget tapes, and when no more are to be loaded, displays income and expenses to date, and either the happy "income exceeds expenses by $___" or the discouraging "expenses exceed income by $___." For its very last step the program lists all expenses by code and amount.

As the text notes, "This package is far more than a checkbook balancer, rather it is a business-like approach to total finance management." For any person willing to take the time to run these programs and enter all the data, this package does indeed give precise information on where all the money went.

For those who find that although the Personal Finance Package was helpful at first, but either they got tired of all the work involved, or would rather do their figuring on the backs of old envelopes, the four program tapes can be used for writing your own programs if you first tape over the punched-out "erase protect" tabs at the rear of these cassettes. Otherwise they can't be written on.

Coming Hardware. You can expect to see these in the near future; in fact, most of them may be available right now:

- "Quick Printer," similar to the Centronics P1; $499.
- New RS-232 board; $99.
- Telephone interface, 300-baud, acoustic coupler, originate-only, half or full duplex; $149.
- "System Desk," a small secretary's desk, with cutouts for the monitor and expansion chassis, hides all the cables; $199.
- Printer stand, for any size Centronics printer; $99.
- Technical Reference Handbook, for Level-I and II, with logic diagrams; $9.95 at Radio Shack stores.

Coming Software. Plans at Radio Shack are, at this moment, to have available by Jan. 1, in the business area: general ledger, inventory, accounts receivable, and mailing-list programs. Also an advanced payroll program, with all 50 state-tax tables built in, and with 10 different types of deductions.

For fun and math, these are scheduled, also by Jan. 1: a games package, a music generator, several other specialized games in the amusement area; and some advanced statistical programs including time-series analysis and multiple regression.

A RENUM tape is already out. This feature, for renumbering program lines, was part of the original Microsoft extended BASIC, but was eliminated when that interpreter was slimmed down to fit the 12K available for the TRS-80 version.

Puzzle. Using PRINT RND(10), you get a fairly good distribution with a large enough number of RUNs. But when you use PRINT RND(RND(10)), the distribution is skewed toward the lower numbers, with more ones than any other number, followed by twos, then threes, etc. Why? (Clue: what will RND(2) generate?) ■

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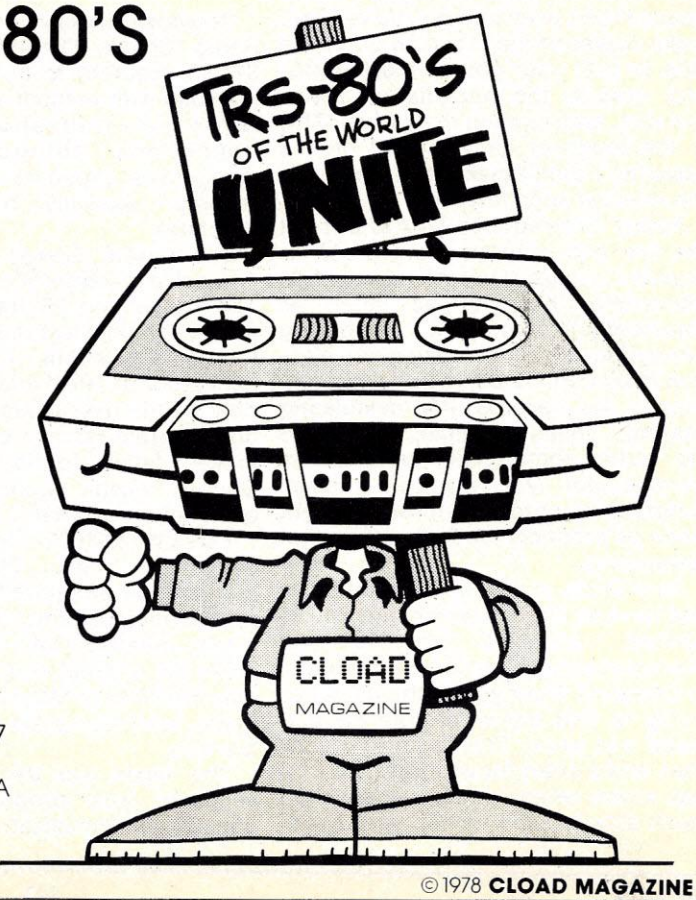

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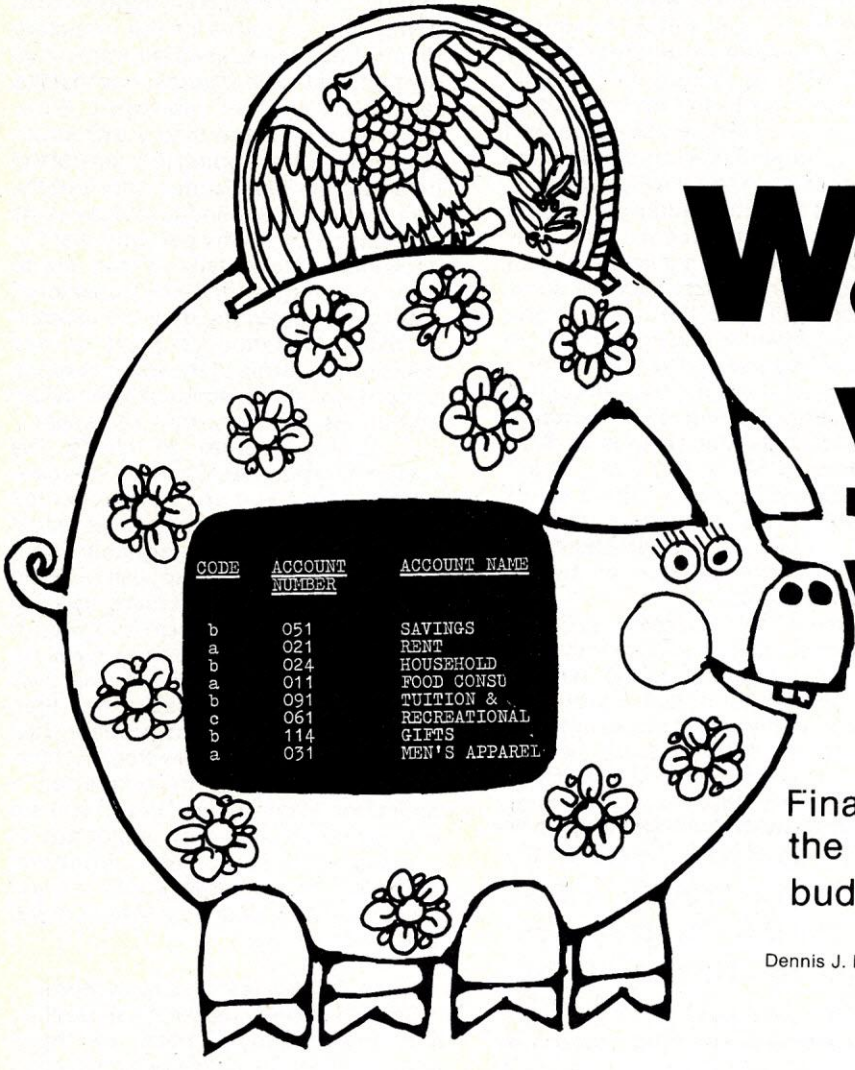


Watch your wallet!

Dennis J. McGuire, Ph.D.

Financial behaviorism, and using the home computer for home budget management.

Dennis J. McGuire, Ph.D., 4281 Henderson Pl., Syracuse, NY 13219.

Can you account accurately for the dollars you have spent today? This week? This month? This year? If you *did* have an accurate accounting of all these dollar expenditures of yours would you know what it meant and what direction this accounting could give to your spending? I can give you an accurate accounting of every dollar I've spent during the last twenty months, but what I think is more important, I can show how a methodical interpretation has directed me in my decisions about spending my money.

Home Budget Management indicates that we are talking about your personal expenditures, your after taxes, out-of-pocket daily expenditures. The home that we are discussing is called a consumer unit, i.e., a group of people living together who pool their incomes and draw from a common fund for their major items of expenditures or persons living alone or in a household with others but who are financially independent. We all know what budgets are—we only have so much money to spend and we want to buy practically everything in sight, and we have to make decisions about how much to spend on this and that. There are the so-called fixed expenses of living and then there is hopefully money left over to use according to our needs, desires, impulses and goals. Now, I think that before any realistic management practices or policies can be determined for any given individual it is necessary to have an accurate accounting of what that individual's actual expenditures are.

A New Science

I think the microcomputer makes this possible. The age of the microcomputer, which is dawning upon us, makes an empirically based theory of personal financial behaviors feasible, and in short, I believe that the age of the microcomputer will give birth to a totally new behavioristic science, the science I call Financial Behaviorism. Financial Behaviorism is the science of observing all one's personal financial expenditures and interpreting them consistently as measures of personal decisions so that such decisions can be made with maximum intelligence.

The microcomputer makes it feasible for you to keep a record of all your daily expenditures. Everyone I talk to about this knows of someone who kept records of his personal expenditures for years. It may be an aunt or uncle, a grandparent, a friend, some other relative, maybe yourself, who for some period of time kept track by hand of his or her expenditures. Have *you* ever heard of anyone doing this? Businesses are *required* to do this but

there *are* some individuals who do this. When I describe this process to an individual in conversation he usually states the opinion that people won't bother to keep accurate records of their expenditures, but when asked if he would do so himself the individual typically says that he would. Many people may do this for years and never get any kind of methodical interpretation from their records. If you look at a hand kept accounting book with page after page of numbers on it, without totals and mathematical analyses of all the figures, you may wonder about the use of keeping such records. Why would anyone bother to keep track of all his personal expenditures? It *is* a chore to do this by hand. In spite of this, there are a few individuals who have kept strict records even without the rewards of analysis and interpretation.

If you look at a hand kept accounting book with page after page of numbers on it, without totals and mathematical analyses of all the figures, you may wonder about the use of keeping such records.

The microcomputer makes it easy for you to record and analyze your personal expenditures over any length of time. It is the value of the analysis that makes it worth your time and energy to keep track of your personal expenditures. This process has the power to make your life more purposeful by giving you an understanding of yourself in terms of your personal expenditures.

The Process Of Financial Behaviorism

The process itself is simple to understand. Each expenditure that a person makes can be categorized. My Standard Personal Expenditure Accounting System is detailed in the May '78 issue of *Creative Computing*. If you can get a hold of that copy I suggest you take a look at the accounting system I have developed for personal expenditures. Everything is accounted for. If you think anything is omitted you can add it to the list and I would appreciate hearing about any such additions.

Once you record the expenditures in your microcomputer it is stored in the microcomputer's memory and many kinds of mathematical operations for interpretations can be made. The microcomputer accumulates your expenditures by type of account over the month's time and ranks them to give you a monthly report. Not only is every dollar you spent accounted for, such as expenditures for food, shelter, personal care, transportation or whatever, but every expenditure is ranked by order of the highest to the lowest. The dollar amounts and the relative percentages are given in the report.

Now this is very simple to understand. I can give you examples from my own records. For January 1977, twenty months ago, up to the present time, I could give you my expenditures ranked for every month. For example, January 1977, I put $365 into a savings account, spent $268 for auto insurance, $225 for rent on an apartment, $140 for professional medical services, $138 for household furnishings, $98 for food, and so on right down the line. I can give you the expenditures right down to $1.00, that in January 1977 I spent on a lottery ticket. I have the total amount of money spent during that month—I spent $1620, so the savings of $365 represents 22.5% of the total. I have such a record for every month of the year 1977. This procedure then is simple enough to understand—all expenditures are categorized by account and ranked.

"Well, so what," you may say. "Who really cares how much money you spent on this and that during January 1977?" As a matter of fact, my original motivation really was to answer the age old question, "Where does it all go?" But after doing this for a few months I discovered that there was a strategy underlying all my expenditures that I hadn't been aware of. I had been methodically trying to increase my net worth and my expenditure rankings revealed this to me. From that point on, I became much more conscious of how my expenditures related to this purpose and started making decisions that I could not have been prepared for without this knowledge.

"Well, so what," you may say. "Who really cares how much money you spend on this and that during January 1977?"

These examples of my January 1977 expenditures that I've provided emphasize the empirical nature of Financial Behaviorism. If everyone kept such records during 1977, no two of them would be exactly the same. Your record is completely personal to you, completely unique. It is descriptive of you alone and, if compared somehow with the records of others, it would show how you differ from them in your financial behavior. Yet, as personal as this record is, it is completely objective. That is, the data is totally factual. The rankings of your personal expenditures present a completely factual description of your behavior, not subject to the bias of some other observer.

Rankings As Strategies

These rankings of expenditures represent strategies in spending money. One of the first insights I had in doing this, in terms of the monetary theory I had while keeping track of all my financial expenditures, was that the rankings represent strategies. Now, there must be some theory that structures how you are going to interpret the data and my idea, stated very simply, was that every expenditure represents some decision on my part and that the decisions I make daily, if they are to have any chance for being considered intelligent behaviors, must be capable of being evaluated as good or bad decisions in terms of the basic purpose underlying all my financial behaviors and all the decisions they represent.

A strategy serves to clarify the underlying purpose of all your expenditures and if you are a goal-oriented person this is probably the most important thing to understand about yourself. In general, I suppose it is valid to say that the goal I'm talking about is to improve your standard of living. If you are not goal-oriented and you do not seriously want to improve your standard of living maximally, then Financial Behaviorism is probably just an interesting adventure that is entertaining to observe in others as a spectator. However, as I say, if you are goal-oriented it is very important to understand your own financial behaviors and what they can tell you about yourself and what you're doing with your money.

Three Categories Of Expenditures

So the rankings represent strategies, and after keeping track of these rankings over the past twenty months I have come to the idea that there are three basic *categories* of personal expenditures. The first is to survive. Certain expenditures are identified as survival expenditures—food, shelter, clothing, personal care, transportation, health care and some others. Survival expenditures represent your standard of living, what you consider to be essential life style requirements. Any expenditure that you make because you believe it is necessary to maintain you in your present standard of living is a survival expenditure. Your expenditures for food consumed at home may be very low as exemplified by the so-called "Coupon Queen" of Lakehurst, New Jersey, who has been getting media attention lately because she has a certain way of shopping with coupons and manufacturer's rebates by which she gets a lot of food and household items at minimal cost. Or your expenditures for food may run

into thousands of dollars and include the services of your personal chef. For wealthy persons who have their own chef and spend $25,000 per year for food consumed at home, including the services of their chef, such expenditures are survival expenditures. In order for them to survive at their standards of living those are the kinds of expenditures they have to make.

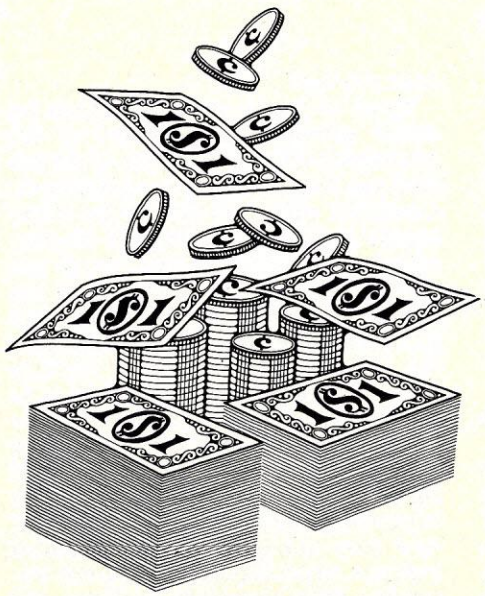
When you buy stocks and bonds, they may increase or decrease in value as time goes on, but nevertheless, your purpose in buying them is to increase your net worth.

The second category is to increase your net worth, to augment your own personal financial growth. For example, money that you put into a savings account, or into short or long term financial or business investments, represents personal expenditures whose purpose is to increase your net worth. I think also that money spent for durable goods that maintain or increase their market value is money spent to increase your net worth. When you buy stocks and bonds, they may increase or decrease in value as time goes on, but nevertheless, your purpose in buying them is to increase your net worth. You hope they will increase in value and the process of Financial Behaviorism is to record and analyze your expenditures in terms of your purpose at the time you made them. That's why such expenditures would be categorized as those intended to increase your net worth. The same holds for home furnishings, equipment and appliances. When buying durable goods, if you have in mind their future trade-in value or resale value then such expenditures can be classified as those to increase your net worth. For example, when buying an automobile, if you take into consideration its market value in the future and this is important to you, then even though transportation may be a survival expenditure, this expenditure is for your financial growth to the extent it holds its market value. The microcomputer can be programmed to record part of such expenditures as survival and part as increasing your net worth. For example, if you spend $10,000 on a car that you can trade in next year for $8,000 then the $2,000 depreciation is a survival expenditure and the $8,000 base which maintains its market value is to increase your net worth.

A friend of mine recently asked how a microcomputer could help him decide what to do if his washing machine broke down. The machine is twelve years old and he has two options, to buy a new machine or repair the old one. The answer could be determined by a microcomputer's analysis of his real on-going operational strategy. If it is predominantly an increase-net-worth strategy he will probably buy a new machine, since most of the money he puts into the machine would be categorized as increasing his net worth. If it is predominantly a survival strategy he will probably have the old machine repaired, which is purely a survival expenditure.

The third category is to enjoy your wealth. Such enjoyment includes having fun in the sense of recreation; all expenditures for goods and services for recreational purposes represent enjoyment of wealth. Dining out, hotel-motel charges, luggage and gambling are also classified as enjoyment of wealth. If you buy a boat for recreation, such an expenditure would be classified as the enjoyment of wealth. As before, with the purchase of a car, you might want to have your microcomputer break down the expenditure to two classifications. Supposing a boat cost $25,000 and after a year's use you can trade it in or sell it for $20,000. Then the $5,000 depreciation is classified as an expenditure for the enjoyment of wealth and the $20,000 base value is an expenditure to increase your net worth.

Gambling is enjoying your wealth; you are playing with your money for the fun of it. If you gamble professionally and manage to make money at it, you would classify your expenditures as financial growth expenditures.



For the most part recreational goods such as sports equipment, games, recreational vehicles, recreational services like entrance fees to movies, stage shows, sporting events, etc., books, tobacco, alcohol and non-medical drugs are expenditures that represent the enjoyment of wealth.

Category Ratios

Each of these three categories is likely to be represented in your expenditures for any given month. The microcomputer can automatically compute the ratio of each category to the others to determine your predominant strategy.

As each expenditure is recorded in your microcomputer it is automatically accumulated with previous expenditures by specific account, e.g., every time you record a purchase of food it is accumulated to your food expenditures for the month, and the expenditures are automatically categorized, e.g. food expenditures are also accumulated into the survival category and, as such, added to expenditures for gasoline, fuel and utilities, personal care, etc. All expenditures to increase net worth are likewise grouped so at the end of the month you get a report on how much money was spent on surviving, how much on increasing your net worth and how much on enjoying your wealth. To compare the three, your microcomputer will compute the ratio of the three categories by taking the lowest figure and dividing it into each of the category amounts. For example, if expenditures to enjoy your wealth were 5% of the total, increasing your net worth was 45%, and surviving was 50%, then dividing each by 5%, the lowest amount, yields a ratio of 10 to 9 to 1 for survival, increasing your net worth, and enjoyment of wealth respectively.

Such analytic reports by the microcomputer show you the factual basis by which any budgetary decisions you have to make can be directed. You can go along with whatever your microcomputer shows your predominant strategy to be in deciding how to spend certain of your funds, or you can try to change your strategy to one that is really more consistent with your actual financial condition. A person may have a microcomputer report that indicates 25% of expenditures are for survival, 15% for increasing net worth and 60% for enjoying wealth. However, the same person may not own any wealth—the wealth may belong to others as is the case with a 26-year-old woman living with her parents.

The Observational Possibilities Of The Microcomputer

This whole analytic and interpretative process is only made possible

by the microcomputer and makes it feasible to ask all kinds of questions that define a new field of inquiry, i.e., a new science, that of human financial behaviorism. This science is made possible by the fact that many people can have microcomputers for their own use and the mass of data that can be accumulated from them could be analyzed to establish the answers to many questions.

Open questions for investigation are: What ratios of the three basic categories are healthy, i.e., can be maintained consistently over long periods of time? What ratio is most desirable as a lifestyle goal? Should it be 1 : 1 : 1, i.e., the amount of money you spend to survive and maintain your standard of living, to increase your net worth and to enjoy your wealth are all equal? This question should be answered by empirical investigations.

What patterns of ratios are likely to occur while going from one lifestyle or standard of living to another? For example, as a person increases his standard of living and grows wealthy, how do his expenditure strategies change? Are there specific phases or stages of development to be expected as normal?

How can mistakes in judgment be detected and evaluated by the microcomputer producing its monthly reports? How can you know when an expenditure decision is harmful to your basic lifestyle goal?

How do the expenditures of the various members of a family affect the family as an economic unit? If you have children, how would you classify their expenditures? Could some children participate in the process of financial behaviorism and would such participation make them more intelligent about using money?

Fig. i. The Personal Expenditures Accounting System (PEAS).

THE PERSONAL EXPENDITURES ACCOUNTING SYSTEM (PEAS)

Expenditure Code:

a: to survive
b: to increase net worth
c: to enjoy wealth

FOOD:

a 011 non-taxed food consumed at home
a 012 taxed food items
c 013 dining out

HOUSING:

a 021 rent
b 022 home ownership (purchase & financing, maintenance & repairs, commodities, services)
a 023 fuel & utilities (fuel oil, coal, gas, electricity, other utilities)
b 024 household furnishings (textiles, furniture, floor coverings, appliances, other durable housefurnishings)
a 025 household operation (housekeeping supplies, housekeeping services)
a 026 personal property insurance
c 027 hotel & motel bills
a 028 telephone

CLOTHING:

a 031 men's apparel
a 032 boy's apparel
a 033 women's apparel
a 034 girl's apparel
b 035 jewelry
a 036 cleaning & repair of clothing
a 037 personal care (toilet goods, beauty & barber shop services)
c 038 luggage

TRANSPORTATION:

b 041 purchase of automobile
a 042 gasolene
b 043 auto parts
a 044 auto repair
a 045 auto maintenance (oil, washing antifreeze, etc.)
a 046 parking
a 047 tolls
a 048 auto insurance
a 049 purchased transportation (buses, taxicabs, trains, airplains, etc.)

SAVINGS & FINANCIAL INVESTMENTS:

b 051 savings deposits
b 052 short-term investments
b 053 long-term investments

RECREATION:

c 061 recreational goods (sports equipment, games, etc.)
c 062 recreational services (entrance fees, etc.)
c 063 subscriptions for magazines
c 064 books
c 065 tobacco products
c 066 alcoholic beverages
c 067 non-medical drugs

PERSONAL BUSINESS:

b 071 postage
b 072 services (printing, etc.)
b 073 supplies
b 074 equipment
b 075 brokerage charges & investment counseling
b 076 legal services
b 077 bank services
c 078 expenses of handling life insurance
a 079 funeral & burial expenses

MEDICAL CARE & INSURANCE:

a 081 professional medical services
a 082 prescriptions & drugs
a 083 hospital services
a 084 health insurance
a 085 opthalmic products
a 086 orthopedic appliances

EDUCATION:

b 091 tuition & fees for formal ed.
c 092 musical & other instruction
b 093 textbooks & supplies

PERSONAL INSURANCE:

a 101 life insurance

MISCELLANEOUS:

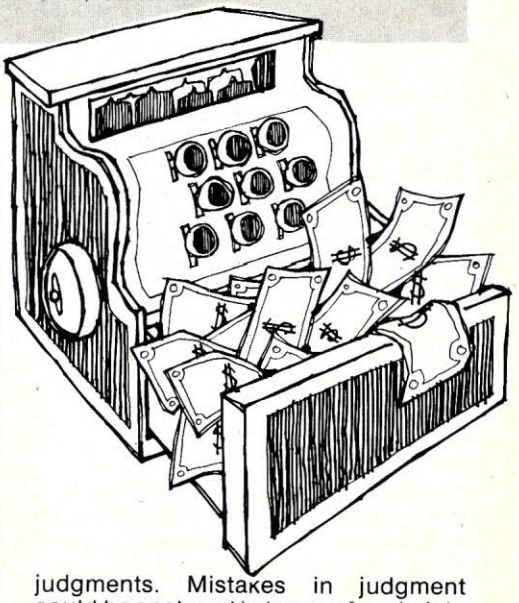
a 111 alimony
c 112 gambling
a 113 support payments
b 114 gifts
- 115 sales tax
c 116 miscellaneous
c 117 contributions

Can computer programs in financial behaviorism be used by high schools and colleges to educate their students to a more mature awareness of themselves in terms of how they use their money?

How are the stages of development defined in terms of financial behaviors as one grows from a child to an adult?

Can computer programs in financial behaviorism be used by high schools and colleges to educate their students to a more mature awareness of themselves in terms of how they use their money?

None of these questions could be asked without the existence of the microcomputer in the hands of people who use it to record their expenditures. Centuries ago the microscope made possible whole new fields of inquiry, whole new sciences. We could see worlds that were never visible to the human eye before. This is also true of the microcomputer. It is now possible for people who represent various socio-economic groups in society to analyze their financial behaviors over long periods of time, to accumulate data, and to develop data banks that can indicate what individuals are improving their standards of living and how they are doing it. It could also indicate what individuals are not improving their standards of living and how their financial behaviors represent their subjective personal values, their judgments. Mistakes in judgment could be analyzed in terms of such data banks. The observational power of the microcomputer opens up to us a whole new universe of data and I think that it is an important one. ■



RANKING OF 1977 EXPENDITURES

Consumer Unit Consisting Of Married Couple With No Dependents

TOTAL EXPENDITURE: $18,560

CODE	ACCOUNT NUMBER	ACCOUNT NAME	DOLLAR AMOUNT	% OF TOTAL EXPENDITURE
b	051	SAVINGS	$3870	20.9%
a	021	RENT	3175	17.1
b	024	HOUSEHOLD FURNISHINGS	1676	9.0
a	011	FOOD CONSUMED AT HOME (NON-TAXED)	1141	6.1
b	091	TUITION & FEES FOR FORMAL EDUCATION	799	4.3
c	061	RECREATIONAL GOODS	786	4.2
b	114	GIFTS	498	2.7
a	031	MEN'S APPAREL	481	2.6
a	023	FUEL & UTILITIES	466	2.5
a	033	WOMEN'S APPAREL	431	2.3
a	042	GASOLENE	402	2.2
-	115	SALES TAX	392	2.1
a	084	HEALTH INSURANCE	364	2.0
c	013	DINING OUT	360	1.9
a	048	AUTO INSURANCE	346	1.9
a	081	PROFESSIONAL MEDICAL SERVICES	328	1.8
a	037	PERSONAL CARE	316	1.7
b	027	HOTEL & MOTEL	288	1.6
a	028	TELEPHONE	286	1.5
a	049	PURCHASED TRANSPORTATION	272	1.5
b	072	PERSONAL BUSINESS SERVICES	225	1.2
a	025	HOUSEHOLD OPERATIONS	219	1.2
a	044	AUTO REPAIR	166	0.9
b	043	AUTO PARTS	135	0.7
c	063	SUBSCRIPTIONS FOR READING MATERIAL	128	0.7
a	045	AUTO MAINTENANCE	106	0.6
b	071	POSTAGE	97	0.5
a	047	TOLLS	96	0.5
c	067	NON-MEDICAL DRUGS	90	0.5
a	101	LIFE INSURANCE	87	0.5
c	066	ALCOHOLIC BEVERAGES	83	0.4
a	083	HOSPITAL SERVICES	75	0.4
c	062	RECREATIONAL SERVICES	66	0.4
a	012	TAXED FOOD ITEMS	52	0.3
a	045.1	AUTO FEES	47	0.3
a	082	PRESCRIPTIONS & DRUGS	41	0.2
b	073	PERSONAL BUSINESS SUPPLIES	38	0.2
a	046	PARKING	33	0.2
c	065	TOBACCO PRODUCTS	33	0.2
c	064	BOOKS	28	0.2
a	036	CLEANING AND REPAIR OF APPAREL	25	0.1
c	112	GAMBLING	13	0.1
	---	ALL OTHER ACCOUNTS	0	0.0

Category	%	Ratio
a: to survive	48.4	5.6
b: to increase net worth	41.1	4.8
c: to enjoy wealth	8.6	1.0

Fig. 2. Ranking of 1977 expenditures. Consumer unit consisting of a married couple with no dependents.

FINANCIAL BEHAVIORISM EXPENDITURES

TOTAL FOR JANUARY: $1620

CODE	ACCT. #	ACCOUNT NAME	EXPENDITURE	% OF TOTAL
b	051	SAVINGS	$365	22.5%
a	048	AUTO INSURANCE	268	16.5
a	021	RENT	225	13.9
a	081	PROFESSIONAL MEDICAL SERVICES	140	8.6
b	024	HOUSEHOLD FURNISHINGS	138	8.5
a	011	FOOD CONSUMED AT HOME (NON-TAXED)	98	6.0
b	091	TUITION & FEES FOR FORMAL EDUCATION	75	4.6
c	013	DINING OUT	34	2.1
a	023	FUEL & UTILITIES	31	1.9
c	063	SUBSCRIPTIONS FOR READING MATERIAL	30	1.9
a	082	PRESCRIPTIONS & DRUGS	27	1.7
a	025	HOUSEHOLD OPERATIONS	24	1.5
a	028	TELEPHONE	24	1.5
b	072	PERSONAL BUSINESS SERVICES	24	1.5
-	115	SALES TAX	23	1.4
a	037	PERSONAL CARE	19	1.2
c	027	HOTEL & MOTEL	17	1.0
a	047	TOLLS	14	0.9
b	073	PERSONAL BUSINESS SUPPLIES	11	0.7
a	042	GASOLENE	9	0.6
a	033	WOMEN'S APPAREL	8	0.5
a	046	PARKING	5	0.3
b	114	GIFTS	4	0.2
a	012	TAXED FOOD ITEMS	2	0.1
c	062	RECREATIONAL SERVICES	2	0.1
a	049	PUBLIC TRANSPORTATION	1	0.1
c	064	BOOKS	1	0.1
c	112	GAMBLING	1	0.1
	---	ALL OTHER ACCOUNTS	0	0.0

Category	%	Ratio
a: to survive	55.3	10.4
b: to increase net worth	38.0	7.2
c: to enjoy wealth	5.3	1.0

Fig. 3. Financial behaviorism expenditures for month of January, 1977.

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An Analysis of Change: Differential Equations

Bruce D. Barnett

We live in a changing world. Besides the obvious examples of change ... other less evident examples of change are evolution of animal and bacteriological populations, and money "growing" as it earns interest in a bank. These changing events are expressed by what is known as differential equations.

We live in a changing world. Besides the obvious examples of change, night into day, your hot cup of morning coffee turning cold and all the physical laws describing motion, other less evident examples of change are evolution of animal and bacteriological populations, and money "growing" as it earns interest in a bank. These changing events are expressed by what is known as differential equations. These equations specify the rate of change of a variable (quantity that is allowed to vary) in terms of a known function or expression. A few examples will help clarify this concept and perhaps will enable you to construct some differential equations of your own choosing. You can use the program that accompanies this article to solve the equations you derive.

In setting up a differential equation, first choose any letter or symbol you desire to represent the quantity that will be changing. A dot placed over that symbol will signify that this is a time rate of change of that quantity; that is, it represents how fast the quantity is changing. This in turn is to be equated to a given expression that actually specifies the rate of change. This expression may or may not include the quantity itself and/or time explicitly. Hence it is quite easy to write differential equations. It is quite another matter however, to solve the resultant equation, which requires knowledge of a branch of mathematics known as the calculus. In some cases the equation is easily solved, in others considerable ingenuity must be exercised, while in yet other cases, one must resort to a solution that consists of adding an infinite number of terms or use some approximate numerical method to arrive at an answer. Now for some examples.

Bruce D. Barnett, RD 2, Box 213, Blairstown, NJ 07825.

Example I — Population Growth and Related Matters

Consider the population of rabbits (or even rats). A rather safe assumption one could make about their population is that "the more there are, the more there will be," so that for example if there are 100 rabbits in existence today, there may be 150 rabbits a month from now — an increase of 50 rabbits, while if there are 200,000 rabbits now, the population may have grown by another 100,000 in one month. To write this as a differential equation, let N represent the number of rabbits at any given time. Naturally N will change in time. Let the rate of change of N be denoted by $\dot{N}$ and let this rate of change be proportional to the number of rabbits in existence at any given time, (recall "the more there are, the more there will be"). The differential equation governing this is written as $\dot{N} = KN$. Here K is the factor of proportionality. If K is positive the population will increase; in fact the larger the value substituted for K, the more rapidly the population will expand. For K negative, which denotes a negative rate of change, the population will decrease. One final bit of information is required to provide a single solution to $\dot{N} = KN$ that is characteristic of all differential equations. At any selected time you choose, you need to know a value for the quantity that is changing. In this example you need know N, the population size at any one given time. For example at t = 0 which could represent the present, let's assume there are 100,000 rabbits (N = 100,000). This assignment of values is called an initial condition and is essential to obtain a unique solution to a differential equation. Once having this solution however, you can determine the population of rabbits at any time hence. Figure 1 presents a graph of the number of rabbits vs. time for several values of K, assuming there are 100,000 rabbits at t = 0. These curves and many others can be generated using the accompanying program which is explained in a later section of this article.

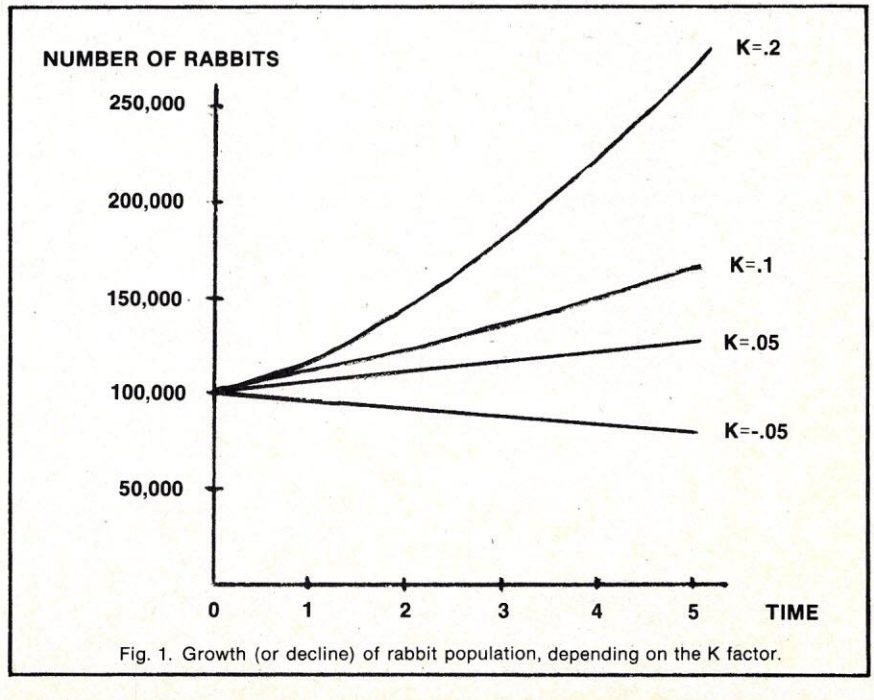

Fig. 1. Growth (or decline) of rabbit population, depending on the K factor.

Believe it or not, but many other seemingly unrelated problems are governed by this same differential equation! This illustrates one of the beauties of mathematics whereby one equation or even an entire theory may apply to many different fields. Some examples that are described by $\dot{N} = KN$ are radioactive decay, mixing of solutions and continuous compounding of interest. Let's look at the latter example more carefully. Assume that you have invested $100 in a savings account that earns 6 percent interest. How much money would you have at the end of 10 years if interest is compounded annually, semi-annually, daily, ... continuously? Table I gives answers to these questions. The differential equation that applies to the continuous compounding is $\dot{P} = .06P$. Here P represents the principal at any time t. Note again that the larger P becomes, the larger $\dot{P}$, the rate of change of P, becomes and the faster your money will grow. As the initial condition, P = $100 at t = 0 was used; t is expressed in years, and .06 represents the annual interest rate. Again, curves similar to that of the population expansion can be generated using the appended program in which you can substitute different interest rates and determine how much money you can save for different principals at any future time.

Compounding Interval	Amount At End Of 10-Year Period
Annually	$179.08
Semi-Annually	$180.61
Daily	$182.20
Continuously	$182.21

Table I. Ten years of interest on $100, compounded at various intervals.

Example II — Various Motions of a Ball

As a second example, let's consider the motion of a ball that is moving at a constant speed as might be the case if it is rolling on a level plane under ideal conditions. Constant speed means that the rate of change of speed is zero. The differential equation would then simply be $\dot{S} = 0$, where S denotes the ball's speed. If the ball is dropped from a window, however, the picture will be quite different and the ball continually gains speed as it falls. In the absence of air resistance, the rate of change of the ball's speed is proportional to the gravitational attraction, thus the governing equation is $\dot{S} = g$ (where g is a given constant). Solving this equation you will find that the speed of the ball will increase without limit, that is, will continue to accelerate. The most interesting case arises when air resistance is introduced. Air resistance tends to slow the ball somewhat; in fact the faster the ball travels, the more effect air resistance has on its motion. What will the motion of the ball be like now? Will it still increase its speed without limit? One can account for air resistance by introducing a term that depends on the ball's speed. Physical experiments suggest adding a term that is proportional to the square of the speed, namely KS^2. Here K is a mixture of physical constants that involve the shape, size and weight of the ball as well as the density and viscosity of the air. This term, when added to the gravitational influence, produces the differential equation $\dot{S} = g - KS^2$. The term KS^2 is introduced with a negative sign since it acts to decrease S. Figure 2 results when using a value of 32.2 ft/sec^2 for g and a value of .001 for K. For an initial condition, the ball is assumed to start from rest, at t = 0, S = 0. The solution for the equation $\dot{S} = g$ is shown also for the same initial condition as above. The reader may want to experiment with other laws such as assuming the air resistance is proportional to the cube of the speed, which applies under certain circumstances, to see what motion results for that case also.

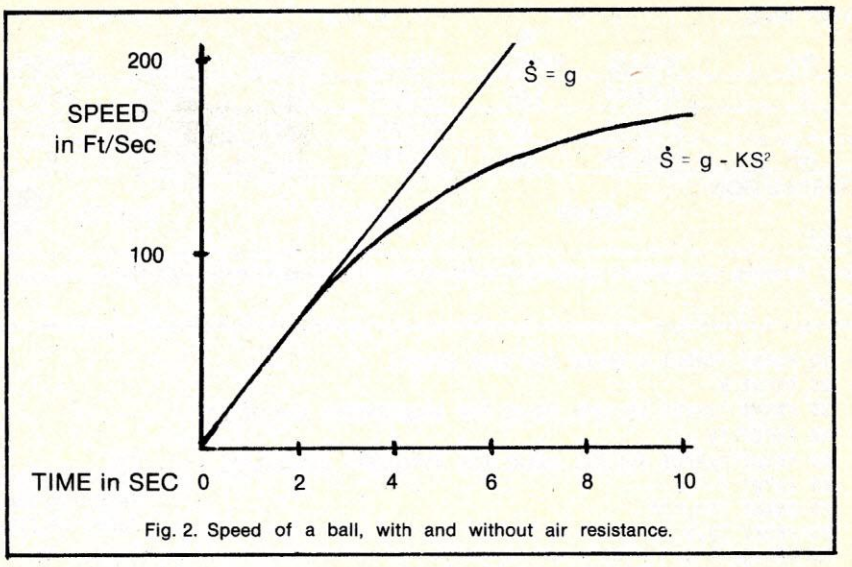

Fig. 2. Speed of a ball, with and without air resistance.

What was presented is only a small view of how and where differential equations arise. Other examples described by such equations are mass-spring systems, electric circuits, deflection of beams and orbital mechanics. One can truly go on and on. Differential equations are necessary and do indeed help describe the "changing" world we live in.

Using the Program

The accompanying program solves differential equations numerically, hence any solution so obtained will only approximate the true solution. For differential equations that cannot be solved directly — and a numerical solution must be resorted to — the mathematician will not only be interested in obtaining the approximate solution but will ask how well the numerical solution indeed represents the true solution. The accompanying program was written to allow you to experiment and exercise your own judgement regarding this question of accuracy. Typically the numerical solution of a differential equation is more accurate the nearer one is to the initial condition; thus as one progresses further from this given condition the less accurate the result. This phenomenon is not unlike the situation where a story or rumor is passed on in turn from person to person, where the more people involved (the further away the story can travel from the source), the more distorted the story becomes. What can be done about this? Well, besides performing a tedious error analysis to limit the error, you can usually still judge how good the solution is simply by rerunning the program using a smaller step size. In fact, continue this process until the solution, at the point you are interested in, changes very little from run to run. Your final solution should then be a good estimate of the true solution. The smaller step size is somewhat analogous to using more capable people who can transmit the "story" more accurately. Table II illustrates these concepts for the equation $\dot{N} = 3N$ for the given initial condition t = 0, N = 1.

STEP SIZE	t = .5		t = 1.5		t = 3.	
(H)	VALUE	% ERROR	VALUE	% ERROR	VALUE	% ERROR
.5	4.39844	1.86	85.0933	5.47	7240.87	10.64
.1	4.48134	.01	89.9958	.02	8099.25	.05
.05	4.48166	0	90.0156	0	8102.81	0
TRUE SOLUTION (N=e3t)	4.48169		90.01713		8103.08	

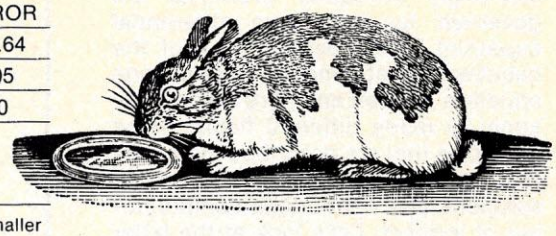

Table II. Showing how the error percentage is minimized when using a smaller step size and smaller value for t.

```
10 PRINT "INPUT A VALUE FOR STEP SIZE";
20 INPUT H
30 PRINT "INPUT INITIAL VALUE FOR INDEPENDENT VARIABLE";
40 INPUT T0
50 PRINT "INPUT INITIAL VALUE FOR DEPENDENT VARIABLE";
60 INPUT Y
70 PRINT "T","Y"
75 PRINT T0,Y
80 LET N1 = 0
90 LET N1 = N1 + 1
100 LET T1 = T0 + H + (N1 - 1)*H*10
110 FOR T = T1 TO T1 + 9*H STEP H
120 LET I = T
130 LET D = Y
140 LET F = 3*D
150 LET K1 = H*F
160 LET I = T + .5*H
170 LET D = Y + K1/2
180 LET F = 3*D
190 LET K2 = H*F
200 LET D = Y + K2/2
210 LET F = 3*D
220 LET K3 = H*F
230 LET I = T + H
240 LET D = Y + K3
250 LET F = 3*D
260 LET K4 = H*F
270 LET Y = Y + (K1 + 2*K2 + 2*K3 + K4)/6
280 PRINT T,Y
290 NEXT T
300 PRINT "WANT TO CONTINUE WITH THIS PROBLEM?"
310 PRINT "TYPE 1 IF YES, 0 IF NO"
320 INPUT N
330 IF N = 1 THEN 90
340 PRINT "WANT TO SELECT ANOTHER INITIAL CONDITION OR"
350 PRINT "SELECT ANOTHER STEP SIZE? (1 = YES,  0 = NO)";
370 INPUT N
380 IF N = 1 THEN 10
390 PRINT "HOPE YOU HAD FUN  ...BYE"
400 GOTO 999
999 END
```

```
run
INPUT A VALUE FOR STEP SIZE? .5
INPUT INITIAL VALUE FOR INDEPENDENT VARIABLE? 0
INPUT INITIAL VALUE FOR DEPENDENT VARIABLE? 1
T             Y
 0             1
 .5            4.39844
 1             19.3463
 1.5           85.0933
 2             374.278
 2.5           1646.24
 3             7240.87
 3.5           31848.5
 4             140084
 4.5           616149
 5             2.7101E+06
WANT TO CONTINUE WITH THIS PROBLEM?
TYPE 1 IF YES, 0 IF NO
? 1
 5.5           1.19202E+07
 6             5.24302E+07
 6.5           2.30611E+08
 7             1.01433E+09
 7.5           4.46146E+09
 8             1.96234E+10
 8.5           8.63125E+10
 9             3.7964E+11
 9.5           1.66982E+12
 10            7.34462E+12
WANT TO CONTINUE WITH THIS PROBLEM?
TYPE 1 IF YES, 0 IF NO
? 0
WANT TO SELECT ANOTHER INITIAL CONDITION OR
SELECT ANOTHER STEP SIZE? (1 = YES,  0 = NO)? 0
HOPE YOU HAD FUN  ...BYE
```

Note that for a step size of .5 and at t = .5, a 1.86% error is made which grows to 5.47% at t = 1.5. Notice also that the same approximate answer is obtained at t = 1.5 for both H = .1 and .05. This suggests that 90.0156 is a good estimate of the true solution.

To run the program, follow the instructions as they are printed out for you using the sample run as a guide that helped produce Table II.

The independent variable called for in the program is the variable that you usually have no control over; this very often is time. The dependent variable is the quantity that changes as the independent variable changes. In the examples that were presented, the population size and speed would be considered as dependent variables that depend upon time in order to have a specific value. To change the differential equation in the program simply change line 500 in accordance with the following conventions. Use D to denote the dependent variable, I to denote the dependent variable and the symbol F to denote the rate of change of the dependent variable. Thus the equation $\dot{N} = 3*N$ would be written as F = 3*D which is in the current listing of the program at line 500. As a second example, the equation $\dot{X} = (X*T - 6)/2*T^2$, where T is considered as the independent variable would be entered as F = (D*I - 6)/(2*I*I).

Happy solving!!!

Reference:
Ralston, A., (1965) A First Course in Numerical Analysis, McGraw-Hill Inc., (page 200).

A page of a newspaper is about 0.003 inches thick. If you piled up 2^{50} sheets of newspaper, you would have 1,125,899,906,842,624 sheets. This pile would be over 53,000,000 miles (85,000,000 kilometers) high.

The distance from the earth to the moon is about 240,000 miles, or 386,000 kilometers.

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Pascal becomes software superstar

Programming language has captured fancy of industry in past two years for use in wide range of computers

by John G. Posa.

From the mountain fastness of Switzerland there came 10 years ago a programming language called Pascal. For the first few years of its life it created little stir, but then it began to gain popularity in academia and eventually industry. Today, Pascal is finding its way into machines of all shapes and sizes around the world.

Pascal has exercised the hardware of more than 60 families of computing machines, and new ones are being added to the list at this moment. It has been dubbed "PL/1 done right" and "Basic of the future," and it has been made to run on the ubiquitous 8080 microprocessor, Cray Research's giant, superfast Cray-1, and a host of machines in between..

Kenneth Bowles, director of the Institute for Information Systems at the University of California at San Diego, and his colleagues are now a major force pushing for Pascal in the U. S. They have put together a single-user operating system that an increasing number of people are using and even redistributing as part of their own systems.

Looking back, Bowles feels it was just lucky that Pascal was chosen. While using Algol during a seven-year stint as director of UCSD's Computer Center, he became convinced that the benefits of structured programming practices could not be overemphasized. He also realized that microcomputers would not disappear and that they represented a very cost-effective teaching aid.

Now for a language. About four years ago, Bowles looked to Pascal. Algol just was not general enough and Pascal, which was designed to teach programming in the first place, was starting to be used as an academic tool. "We saw industry producing a number of different machines and we didn't want to be locked into any one in particular," he remembers. "We needed software that would last a long time and could also be traded between various institutions." So portability became an underlying factor in their work.

Pascal, drafted in 1968 in Zurich by Niklaus Wirth was chosen as the starting point, but its memory requirements were excessive. With eyes on the LSI-11 as a target

Pascal con't . . .

machine, Bowles used frequency-based encoding to squeeze the compiler's requirements down to less than 20 kilobytes. (Simply stated, frequency-based encoding rearranges operators so that the most frequently used are the easiest to access.) He got this working on the PDP-11 and knew it would also go on the LSI-11, so in June of last year he reset his sights on the 8080.

Within eight months, Pascal was running on the 8080, and Bowles was stunned. He recalls saying something like, "We've got something here and we'd better let the world know about it." They did. Soon, Pascal was running on Zilog's Z80, and by the end of this year, the language will be routing electrons in the 6800, TI's 9900, and Rockwell International's 6502. In fact, there doesn't appear to be any machine incapable of handling Pascal.

Bowles and his associates work with Pascal's intermediate code called P-code. Pascal programs are first compiled into the P-code, which in turn gets interpreted on the various target machines. This is one reason why UCSD Pascal comes up so quickly. The only code that needs to be written in the native tongue of the target processor is the small interpreter. From that point on, the UCSD system takes over. At this time, some of the major components of the UCSD operating system package include the Pascal compiler with extensions for strings, disk files, interactive graphics, and system programming, an editor, a file manager, a debugger, and various utilities.

Plans at UCSD are to continue to make Pascal more enticing to prospective users by adding target machines and useful extensions. There is also a chance to put Pascal in read-only memory. "All of the code that our compiler generates is potentially ROMable," says Bowles. "It's position-independent, it doesn't modify itself, and our system itself would make it very straightforward to refer to procedures in ROM." UCSD Pascal also just received another boost in the form of a four-chip, 16-bit microcomputer introduced by Western Digital Corp. that actually interprets P-code in hardware (see p. 155).

"It's serendipitous," admits Bowles, "Somehow we happened to be at the right place at the right time with a Pascal system and the microcomputer industry was hurting for a high-level language—and our system will run on just about all the popular processors."

Happy user. One of the many firms adopting UCSD's Pascal is American Microsystems Inc. AMI plans to offer the language as part of its MDC-100 Microprocessor Development Center. Dick Woodward, manager of microprocessor software development at AMI, says, "For defining data structures, Pascal is much more powerful than Basic, Fortran, PL/1, and certainly assembly language. In conjunction with Pascal's control constructs, we plan to cut programming time by a factor of four to five and reduce the cost of maintenance."

The Pascal User's Group is based at the University of Minnesota in Minneapolis; Andy Mickel, the group's coordinator, says he is swamped with inquiries. After two years, the group comprises some 2,600 members from 41 countries and is growing.

Mickel is also a systems programmer at the university's computer center. "Two years ago, we ran less than 1,000 Pascal jobs," he says. "This year it will reach 262,000." He takes no credit for promoting the language's popularity but rather attributes it to the language itself. "Pascal is good on its own merit. It would have been successful regardless," he says.

Group interest. The Digital Equipment Computer User's Society has its own Pascal Special Interest Group, formed about two years ago. Enrollment now stands at approximately 600 and is climbing. According to John R. Barr, a professor in the computer science department at the University of Montana and spokesman for the group, it is evaluating various implementations of Pascal in DEC computers. Now operational is a two-pass compiler that runs in conjunction with the RSX—11/M, RSX—11/D, IAS, and RSTS operating systems; it is being extended to use RT—11 and Bell Lab's UNIX. Other members are adapting Pascal for DEC's new VAX 11/780 system.

Closer to the commercial world, Pascal has been equally successful. For example, Texas Instruments Inc. uses Pascal extensively, though it stops short of calling it the corporate language. Roger Bate, manager of advanced software at TI, says the company surveyed languages about a year and a half ago and narrowed the choice to C, Pascal, and Bliss. Pascal was chosen, but it was apparent that TI had to make some changes to make it "more for programming than for teaching." So the firm's programmers took Wirth's language (which remains a proper subset) and added fixed-point and decimal arithmetic capabilities to it, as well as more versatile array processing.

Pascal usage at TI is on the rise,

What is Pascal?

Pascal is a block-structured programming language in the style of Algol. Programs consist of two parts: a heading names the program and specifies the variables it will use, and the body of the program, called a block, follows. A block is further subdivided into six sections. The first four declare the labels, constants, data types, and variables. The fifth names and precedes an actual procedure or function. The last section, called the statement section, contains the executable code for the named function or procedure.

Labels identify statements so they can be referenced. Constants equate numbers with names for use throughout a program, like pi = 3.14. Data types are numerous; furthermore, structured types can be defined to include arrays, records, sets, and files. Each named variable must be followed by its type. Procedures can be put within procedures, and the statements for each must be preceded with the keyword "begin" and terminated with the word "end." Operators are defined for multiply, divide, add, subtract, logical, and relational, and numerous control statements are allowed.

Pascal con't. . .

with 30% to 40% of the new programs being written in it. Included are those for initial software development, tools like compilers and libraries, and systems programming. In April, TI began offering Pascal for its DS990 disk-based minicomputer systems. The 990 compiler and several 990 system software modules are themselves coded in Pascal. Even Fortran routines can be embedded into TI's Pascal source code.

Another user is Electro Scientific Industries Inc. of Portland, Ore., a manufacturer of instruments and minicomputer-based laser trimmers. "We were coding in assembly language, but realized that we wouldn't be flexible enough to track the needs of our users," says Don Cutler, manager of systems engineering. So, like TI, the company went shopping for a high-level language. Basic and Fortran did not provide the real-time performance sought; PL/1 was too thorny and not benchmarked enough on small machines.

Choice. But Pascal seemed easy enough to understand and implement, so the firm obtained a compiler from the University of Illinois, changed about 99% of it to add things like real-number–processing capabilities, and ESI's software needs were satisfied. "The code generated typically uses only twice the memory and execution time of an assembly version," says Cutler.

But Electro Scientific did not go the P-code route. "When we started about five years ago, there wasn't much being done with P-code," says Cutler. Instead, its compiler generates macrocode and a macro assembler generates assembly code. The macrocode gives ESI certain advantages. For efficient execution, complex operations like fast Fourier transforms can be written in macrocode and embedded directly. Also, macro debuggers for the PDP-11 can be utilized. But Cutler does not scoff at P-code. "Given a random processor, P-code is the only way to go because it's so portable. Microprocessor implementations center around it, and it's the way of the future," he says.

The firm's compiler has spawned a separate company called Oregon Minicomputer Software. It has exclusive rights to market the compiler, which sells for $1,500, and has written versions to run on the PDP-11 with the RT-11, RSX—11/M, and RSTS operating systems. Oregon Minicomputer also has developed symbolic and variable editing packages in collaboration with its parent firm, and is about a year away from an optimized compiler that will be even more efficient, although it may not be appropriate for small machines.

Question. But even as the enthusiasm builds, one may reasonably ask, "If Pascal is so wonderful, why is it that every new user has to practically rewrite it?" The answer stems from the fact that all languages have their shortcomings, and Pascal has some too. First, Wirth's definition does not explicitely outline what is required for the seperate compilation of Pascal programs, and it has been found that either extensions to the language or compiler directives must be added to do so.

Another complaint voiced by some users is that the size of an array must be fixed at the time of compilation. Pascal is very big on type-checking, which means that if a variable is of a certain type (integer, for example) in one part of a program, it must remain that type. This is actually a desirable programming practice, except that if the size of an array changes, it is considered a new type and genuine Pascal will flag it as an error.

In terms of system programming, it can be awkward to introduce modules of the type necessary for concurrent processes. Large arrays must be set up with global variables for the procedures to use, and if one of the variables is altered inadvertently, problems arise.

But complex operating systems can be written in Pascal, as Per Brinch-Hansen proved a few years ago with his Concurrent Pascal. And Wirth himself is now concerned with a new language called Modula that is based on Pascal and aimed at the concurrent-computation problem.

The newer Pascal compilers have all but eliminated some of these headaches. For example, Electro Scientific and others simply insert a dummy header with the variables they will use and add the actual procedure later. And TI has an expression to vary the size of an array without getting reprimanded. The only remaining problem seems to be exactly what extensions should become standard and how they should be implemented. Standards are important not to force their use but to enable those not adhering to them to state in precise terms how they are being different.

Workshop. This summer, UCSD held a workshop to discuss such standard extensions, and over 30 different firms were represented. Many ideas were discussed, including interrupts and the ability to pass procedure and function names as parameters; the report from that meeting will soon be available.

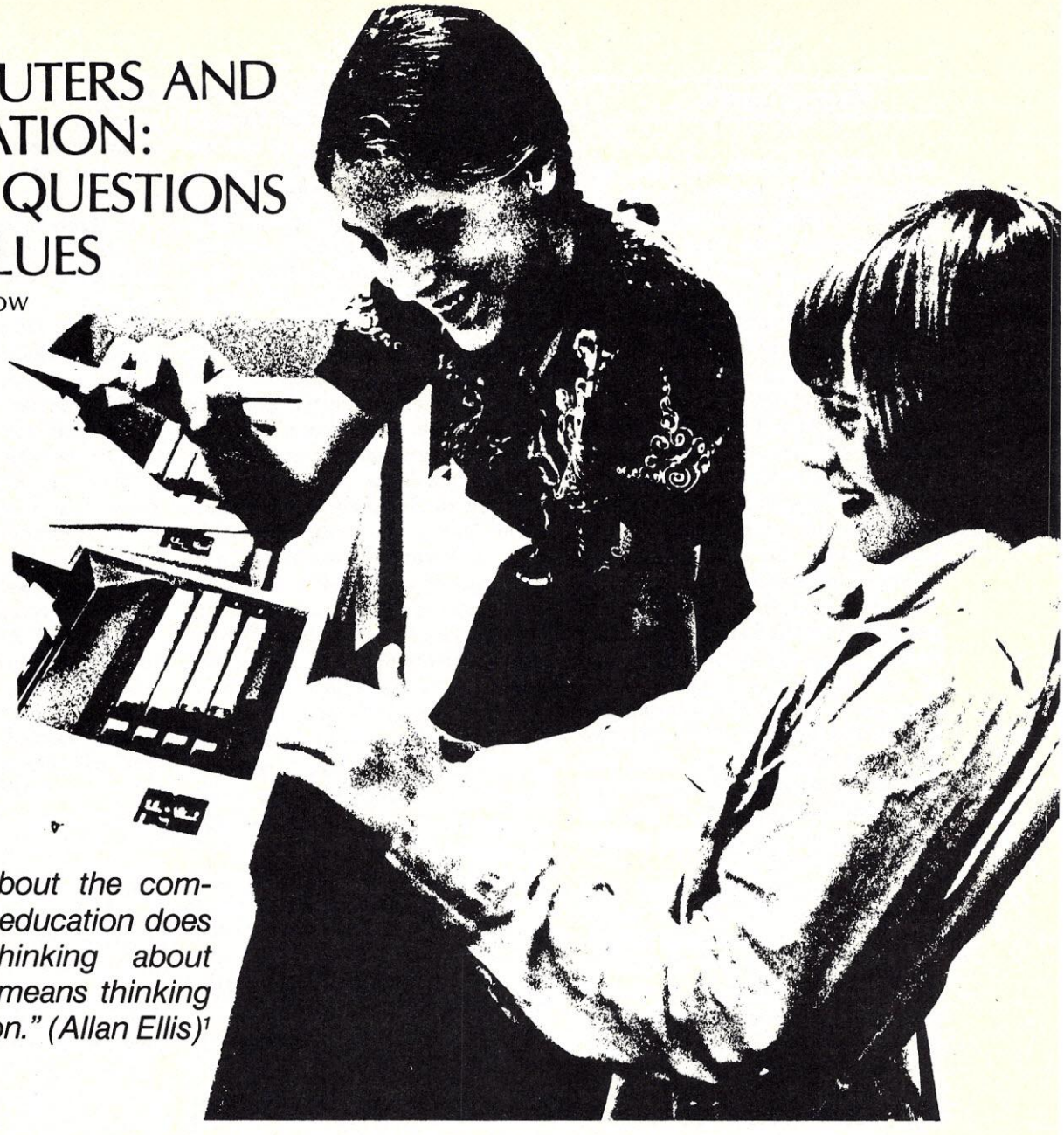
The military, too, began with Pascal to develop its standard language, now in the so-called Steelman phase [*Electronics*, Aug. 3, p. 59]. For a while, it was believed that the result would be Pascal with standard extensions. However, recent documents reveal a widening gap between the Defense Department's language and Pascal, to the extent that Pascal may not even be a proper subset. Compatibility may be possible, however,through filter programs that would translate one language into the other. □

Obeisance to Pascal

Why Pascal? The programming language apparently was named by its author, Niklaus Wirth, for the French philosopher and mathematician Blaise Pascal (1623–1662) for no reason other than the high esteem in which Prof. Wirth holds his teachings. The language is a relatively young one: a preliminary version was drafted at the Technische Hochschule in Zurich, Switzerland, by Wirth in 1968. Two years later, Urs Ammann, also at Zurich and aided by Wirth and colleagues, developed an accompanying compiler for Control Data Corp.'s CDC 6000 computer, and Pascal was off and running.

COMPUTERS AND EDUCATION: SOME QUESTIONS OF VALUES

Daniel Barstow



"Thinking about the computer's role in education does not mean thinking about computers, it means thinking about education." (Allan Ellis)[1]

As an elementary school teacher preparing to expand my own use of computers in education, I, too, am excited about the wonderful variety of games, simulations, tutorials, and other instructional programs that are available. However, I also feel that as teachers, students, developers of programs, and responsible members of our society, we must deal more carefully with a variety of underlying questions of values. Too many people involved with educational computing accept too easily the assumption that any use of computers will improve our schools. Yet every educational tool has its advantages and disadvantages, and can be used in beneficial or harmful ways. Before deciding on the nature of computer applications in our own schools, we each should try to clarify our values and opinions, and better understand the effects of the use of computers, and particular programs, on our schools and our children.

To aid in this process of "values clarification," this article calls attention to several specific areas of concern. This is a complex and controversial issue so I have tried to be open-minded and fair with a variety of points of view. The presentation is a combination of discussion, conjecture, personal opinion, and plenty of questions for the reader. There are educators and computer scientists who have spoken out on these issues. We should pay more attention to their concerns.

Context

First of all, it must be remembered that computers are only one aspect of multi-faceted curriculum and methodology. Programs should not be evaluated in a vacuum, but as supplements to other tools and approaches. The computer is neither a complete teacher, nor a panacea for educational problems. The teacher clearly has a central role in assuring that computer-assisted instruction is balanced by other kinds of experiences.

Selection of Programs and Applications

Computers are the most versatile tool our technology has ever produced, and there is a tremendous variety of programs and applications for educational use. Do users understand the benefits and problems of each kind of application? Who decides what new programs to buy or develop? Is the organization of the program library rigid, or are the inter-relationships

emphasized? (A web diagram might be more helpful than a linear outline.) Have we been fair in our comparison of computer-assisted instruction with other methods? How well have we defined our educational objectives? Should we efficiently focus on the most effective programs, or should we encourage variety and experimentation? It would seem that the ease of access to all of a computer's programs encourages schools to leave many of these questions up to individual teachers.

Some comments about particular kinds of programs:

Programmed Instruction

Programmed lessons, such as drill-and-practice and tutorials, can present well-organized and sequential lessons based on individual student progress. Are the lessons clear and interesting, or are they confusing in their sequence? "The ways computers can be used in education depend on how well we understand the process we want to computerize."[2] Do the developers of programmed lessons really understand the subject matter, or do they just understand computers? For a particular topic, is it helpful to computerize, or would a book or oral lesson be just as good, or better? How easy is it for teachers to prepare drill-and-practice and tutorial lessons? To what extent are students able to use their own judgement in choosing appropriate lessons? Patrick Suppes dreams that "some day millions of school children will have access to the personal services of a tutor as well-informed and responsive as Aristotle."[2A] Is this our goal, or is there a danger that users will expect too much "knowledge" from their computer teacher?

Games

Educators, and children, have long advocated games as a playful way of learning. Do our computer games include both the "playful" and the "learning" aspects? Is our goal to develop game theory and analytical thinking, or to present specific subject matter? Do the games take full advantage of the unique dimensions computers can provide? Is there also ample time for free play and "messing around" with the computer? Are the students really learning, or are they just keeping pleasantly busy? Some people feel uncomfortable with the proliferation of war games (such as the ever popular "Star Trek"). "We are presented with more hunt and kill games in an era where mutual cooperation in complex systems is a vital need." (Gregory Yob)[3] It would seem the solution is to encourage more people to design their own styles of games.

Simulations

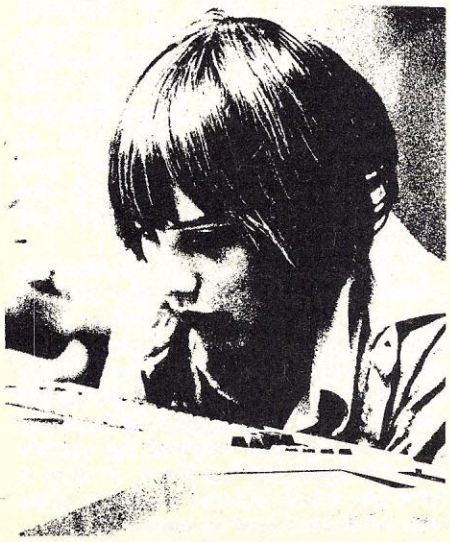
"Computer simulations are often more concerned with learning about the process being simulated than merely reproducing it." (Allan Ellis)[4] How accurate are computer models? To what extent should we impose mathematical values on life? Do computer simulations help us understand real phenomena, or do they delude us with "artificial constructs?" Are instructional simulations replacing or supplementing real experiences? Should computers simulate human emotions? Does the field of artificial intelligence threaten us with a competitive "genius," or does it "open up new ways to think about knowledge and learning?" (Seymour Pappert)[5]

Information Processing

For the purposes of information storage and retrieval the computer offers an extensive memory, ease of access, ability to cross-reference, and the ease of updating information. In what ways can computers improve on current record systems for such things as student data, factual information, cross-referencing of curriculum with materials, and readings from scientific instruments? How helpful can inter-computer networks be for access to information, and programs? Is there a danger that the people who control what is stored might abuse their "editorial censorship?" The responsible user should use critical judgement with computer information, just as he or she would with other media, such as books or television.

Best Utilization?

Some critics of computer-assisted instruction feel the rigidity of the technology does not provide outlets for individual creativity. Others feel that the computer should be considered as a whole new medium for creative manipulation. Theodor Nelson writes "the computer is like a Rorschach inkblot, you make of it some wild reflection of what you are yourself."[6] Certainly the design and development of new programs requires creative insight. For such fields as computer graphics and computer music, is the requisite knowledge base a barrier to most people, or is it a motivation to learn? Are computer poems a new form of creative writing, or are they random generations on which a reader imposes meaning?



In addition to all the instructional programs, a computer can also be used as a multi-purpose tool. Is the computer's use limited primarily to the math department, or is it used in all academic areas? Are the computer's unique capabilities being utilized, or is it merely doing the same work in a different way? Is the computer connected in helpful ways with other media and resources? It is especially important that "computer-naive" teachers be adequately instructed in access to the computer, and that a computer resource person be available as a helpful interface.

Technology

In many ways computers are part of the wider issue of the use of technological devices, of any kind, in education. Does technology expand our reach and simplify our lives, or does it actually complicate our lives and confuse us with gadgetry? A computer is a sophisticated device, and how many teachers really will learn to control and utilize its powers? Yet for those who do, what wonderful new ways to teach will be opened up!

Some people feel that technology dehumanizes education. This may be true, but it is not inherent in the technology, computers can be used in human and inhuman ways. Emmanuel Mesthene writes "The more we can invent machines to do the mechanical work of the world, the more we are freed to do its human work."[7] Yet if teachers relax while students are "computing," human responsibilities have been abdicated to a machine. Perhaps the key question is whether the machines adapt to the humans, or humans adapt to the machines.

Every technology has its limits. For example, there is a limit on the number of simultaneous users of a computer. Should we schedule blocks of time to insure that each student and teacher has a turn, or limit access to those who can best take advantage of its capabilities, or should we emphasize input/output devices, and particular programs, which facilitate large numbers of users (such as batch processing, and team participation in games)? On the other hand, with "time sharing," and a powerful central computer, it is relatively easy and inexpensive to increase the number of users by adding new terminals.

In spite of, or perhaps because of,

great advances in computer design, electrical and mechanical failures can cause complete systems to be shut down, or "crash." Even though company technicians can usually keep the down time relatively brief, any break down can be a sudden inconvenience for all involved.

We must also be realistic in recognizing the danger of "closeted technology." Will we find minimal use of computers after an initial burst of enthusiasm, as has happened with some other technological innovations? Perhaps this just further emphasizes the need for a "computer resource person," or more generally a media specialist, to be in charge of in-service training of teachers, facilitating the acquisition of quality programs, and promoting wise use of the computer.

Expense

In spite of rapidly falling costs, the expense of a computer system is the primary reason that many school districts decide to use computer-assisted instruction. A large comprehensive system, offering administrative and instructional services, might cost several hundred thousand dollars per year for rental, maintenance, and support personnel. Yet a microcomputer can cost under a thousand dollars to purchase. In a time of financial cutbacks, is a computer a wise investment of the educational dollar?

Since many school systems already use computers to help with bureaucratic functions, it might help our understanding of this issue if we consider the cost of a computer as having two components. The administrative budget might pay for the administrative services, such as attendance records, report cards, and payroll. It should be noted that for this component computers frequently offer net savings over comparable services by human personnel. For the other component, the instructional budget would pay for the costs of expansion of the central computer for educational uses, such as additional terminals, and programs. Of course, "instructional cost efficiency" is a very subjective judgement, and we must be fair in our comparisons of computer costs with other methods and materials.

Effects On The Child

"We must find ways to ascertain the impact of this new medium on the quality of the child's model of the universe."[8] Our experiences help form us into what and who we are. Will extensive use of computers cause people to relate to humans in a similar way? Will students become more programmed and rigidly logical in their daily lives, or less spontaneous, or less sensitive to emotions? Will they become more introverted, and "hide" at the Teletype? Or will children gain self-confidence because of success with non-threatening computers, learn to live more creatively because of experiences with creative computing, and become better at problem solving because of experiences with program design?

Computers, along with other media, can provide children with a rich supplement of visual and auditory imagery. Yet these vicarious experiences can also limit the development of creativity and imagination, just as talking dolls limit, rather than expand, a child's free play. Nevertheless, playing with a computer can be a much more valuable experience than sitting, for example, in front of a television. If the appeal of computers reduces the time and interest for pleasure books, computers might hinder reading development. On the other hand, written language is the primary means for learning from and communicating with a computer.

Use of computers can help children develop new ways of thinking. Programming skills such as logic, clarity, and flow-charting can help deal with other problems outside the computer realm. Yet some people feel that our society already suffers from an over-emphasis on the rational and logical side of our brains, to the exclusion of the metaphorical and intuitive.

Does a computer speed and improve learning of factual information, or does the computer's memory and calculating ability do too much of the thinking for the child, and discourage him from learning such things as the math facts? Does computer-assisted instruction further expand the variety of ways a student can learn, or does it take too much control from the child over what and how to learn?

Effects On Schools And Teaching

The use of computers in education could drastically change our schools and the ways we teach. In *Education and Ecstasy*, George Leonard envisions a school of the future with a well-developed and comprehensive computer instructional system that does much of the factual teaching, giving teachers and students more time for "character development," practical experiences and creativity.[9] Others fear a dangerous abdication of educational responsibility to the computer, and mechanized schools. Probably both of these views are exaggerated. I imagine that in many schools the impact will be relatively minor, that computers will just join the ranks of available teaching aids, with some people using them extensively and wisely, while others prefer different methods.

One of the benefits of research in computer-assisted instruction may be the impetus it gives for reconsidering some of our basic educational values. For example, designing a computer's role in individualized education depends on what we mean by individualization. Do we mean individually pacing a single curriculum, or developing a unique curriculum for each child, or recognizing that individual children will respond to the computer in many different ways?

Computers may also have an effect on jobs in school systems. Teachers shouldn't fear for their jobs, since they will always have the central role in the classrooms. However, at the administrative level, some clerical assistants might lose their jobs to automation, or at least should be prepared for a redefinition of their job classification. Also, some new positions might need to be added, such as support personnel for the computer.

The direction our schools go with the use of computers is in an early formative stage. We must look ahead several years, and set long-term educational and computing goals to guide us, and not just stumble along step by step. We must also be sensitive and flexible enough to change our plans as experience helps us understand the issues better. A crucial question is is who determines the direction individual schools will go with computers—administrators, teachers, students, computer companies, the voting public? Another crucial question question is how well do these people understand both children and computers?

Effects On Our Society

Regardless of the educational applications, the increasing use of computers throughout our society will certainly change our lives. Within the next decade, computers may become

the largest industry in this country. Should schools discourage our society's rapid immersion in computer technology, or reinforce it with educational computing?

There are many aspects to this controversial issue. Are computers enabling us to achieve technological progress virtually impossible by other means, such as flying to the moon? Or is this diverting too many resources from social progress? Are computers a necessity for the survival of our large-scale society, or are they a tool of the "establishment" to maintain control over our lives? Are home computers a powerful tool to improve our lives, or are they just a toy for the intellect? Does access to a personal computer even further separate the haves from the have-nots? Should schools and libraries equalize things by offering computer resource centers whose services are available to all in the community? There are many who have spoken out on these and other issues, and most of the concerns expressed elsewhere in this article are even more appropriate to these wider issues affecting our society.

In any case, many people and organizations have already decided in favor of computers. "Computerization of our society has an impact on the social context, and hence on the goals, of education." (Allan Ellis)[10] If we are to prevent subtle, and not so subtle, manipulation by a computer-oriented society, our schools have a responsibility to help prepare students to deal with computers. For some this may mean career awareness and job preparation in the field of computer science. Yet a degree of "computer literacy" is important even for "the school drop-out, who is likely to use, and certain to be affected by, computers." (Walter Koetke)[11]

Computer Abuse And Crime

Computers are machines, and as such cannot distinguish friend from foe. This is opening a new tool for white collar crime. A bank programmer might manipulate records to deposit large sums of money in his or her own account, or change a credit rating for a friend. One capable student in a moment's access to a police computer caused it to print out the names of his teachers as the ten most wanted criminals. Whether for prank or personal financial gain, "there's always a criminal element in society ready to take advantage of everything that comes along." (Donn Parker)[12] At this point legislation dealing with computer crime is almost totally absent, though committees in Congress are now beginning to deal seriously with this issue.

However, in schools the problem of computer abuse might be more difficult to legislate. "The implications for a student's loss of privacy through computerized computer records are considerable." (Barbara Schieffelin)[13] A student's privacy might be violated by excessive or unauthorized computer records, especially if they include errors and unsubstantiated rumors. The idea of a "big brother" watching thoroughly over teachers and students can seem a formidable barrier to personal change and experimenting with alternatives. Yet "cumulative files" can have a similar effect. Abuse of any record system depends on how it is applied. Nevertheless, computer records are unique in some ways, such as the large capacity for data storage, and in the ease of access. On the one hand this can provide a convenient way for teachers and students to record and recall helpful information about themselves, and aid in statistical overviews. On the other hand since terminals might be distributed throughout the schools, they are harder to supervise. Safeguards must be carefully built into the system.

Another problem is the possibility of destroying or changing information in the computer's memory. Even with safeguards there will always be the danger of accidental erasure of programs and data, or that an advanced student might manipulate personal records.

Probably the most crucial issue, though, is how computers contribute to the quality of our children's educations. It is serious abuse if educational computing is carelessly managed, if there is a poor selection of programs, and if the applications hinder rather than expand a child's progress. Yet I also feel that it is serious abuse if we fail to explore the educational potential of this versatile tool.

As with any other kind of educational innovation, computers should not be used in the schools without careful consideration of issues such as those mentioned in this article. Discussion should include all those affected: teachers, students, administrators, computer scientists, parents, and the general public. The issues are complex, and we should not expect yes/no answers. It helps to consider many of the issues as continuums, with a range of values between such extremes as play vs. learning, obstructing personal growth vs. liberating human development and tool vs. master. We should not consider decisions as final, they will always be refined through experience and discussion with others (especially with those who disagree).

Sidney Simon calls attention to several aspects of the values clarification process: contact with alternatives, consideration of consequences, free choice, public affirmation, and acting consistently with one's beliefs.[14] This article focuses on the first aspect—contact with alternatives. I hope it can be a facilitator for further discussion, and action. ■

FOOTNOTES

1. Allan B. Ellis, *Study Guide for Educational Technology and Systems*, p. 71
2. Allan B. Ellis, *Cybernetics and Education: A Colloquium*, p. 4

2A. Patrick Suppes, *The Use of Computers in Education*, p. 207

3. Gregory Yob, *The Best of Creative Computing, Vol. 1*, p. 267
4. Ellis, op.cit., p. 3
5. Seymour Pappert, "Bibliography of LOGO Memos for Distribution," p. 10
6. Theodor Nelson, *Computer Lib/Dream Machines*, p. 2
7. Emmanuel Mesthene, *Cybernetics and Education: A Colloquium*, p. 57
8. XEROX/PARC, *Personal Dynamic Media*, p. 11
9. George Leonard, *Education and Ecstasy*, p. 139-155
10. Ellis, op. cit. p. 95
11. Walter Koetke, *The Best of Creative Computing, Vol. 1*, p. 178
12. Donn Parker, interviewed in "Personal Computing Magazine," January/February 1977, p. 53
13. Barbara J. Schieffelin, *Some Essays on Computers in Education*, p. 15
14. Sidney Simon, *Values Clarification*, p. 19

NATIONAL EDUCATIONAL COMPUTING CONFERENCE
JUNE 25-27, 1979

PURPOSE

The National Educational Computing Conference (NECC) is aimed at providing a broader, richer forum for discussion between individuals, at all levels, with interests in educational computing. As such, it will provide a unique opportunity for the cross-pollination of ideas and experiences which should result in a new, higher quality of educational computing. The planned sessions and related activities will be of benefit to both experienced computer users and new users and will stress the practical nature of such use. The end product should be better education in the classroom.

A cooperative venture undertaken by 12 professional organizations interested in educational computing, NECC has at least four major objectives: (1) presentation in one forum of all major work regarding computers in education in the United States; (2) interaction between individuals involved at all levels in the various aspects of computer uses in education; (3) development of better liaison and coordination between the various professional groups involved with computer uses in education; and (4) production of a proceedings documenting the status of computers in education in the United States.

The conference will be held on the main campus of The University of Iowa, which is adjacent to downtown Iowa City.

SCOPE

Papers are solicited from individuals representing all academic disciplines and research areas in educational computing. Geographically, the entire country is included, and it is expected that some participants will come from abroad. The conference technical areas will include, but not be limited to, the following general topics:

- Computer Science, Engineering, and Information Systems Education
- Computer Usage in the Physical Sciences, Social Sciences, and Humanities
- Curricula Planning in Computer Science, Engineering, and Information Systems
- State and Federal Programs Related to Computers in Education
- Computers in Education at Two-Year, Small Four-Year, and Minority Institutions
- Computers in Education at the Precollege or Early Education Level
- Computer Education for Teachers
- Articulation of Computer Education with Commerce, Industry, and Government
- Health Care and Legal Services Computer Education
- Hardware and Software Resources and Their Administration
- Computer-Assisted Testing and Computer-Managed Instruction
- Computer Literacy and Societal Impact
- Computer Education and Job Opportunities for the Handicapped
- Administrative Data Processing in Colleges and Universities
- Organizational Dynamics in the Computer Profession
- Self-Assessment Programs and Continuing Education
- Accreditation and Certification Programs
- Computer Service Courses and Facilities

The above topics represent broad functional areas of interest in a meeting of this type. Clearly some of these areas are more inclusive than others and, as a result, more emphasis will be placed on them. Efforts will also be made to balance the program based on the interests of the projected attendees. For example, papers from minority institutions, two-year and small four-year colleges will be given special consideration and are especially solicited.

PAPERS

Authors are invited to submit papers describing actual experiences with computer use in the classroom or the consequence of such use upon the education process in general. Papers submitted should report concrete results or be survey or tutorial papers which include a synthesis and thorough evaluation. Generally, papers that describe projects presented at previous conferences are not considered unless substantial new information can be reported, and in this case a brief synopsis of the earlier paper with clear indication of the new information should be provided. It is expected that most papers will report on specific materials, problems, programs, and measures of success or accomplishment. Papers reporting negative results are also encouraged, especially when the results could have a profound effect on the way educational computing should be viewed.

Form

Authors are to submit *an original manuscript and four copies.* Papers should be typed, double-spaced, and are not to exceed 15 pages. Pictorial material should be 8" x 10" glossy, black and white photographs or other illustrations suitable for photoreduction.

The title page of each manuscript must contain the author's name, complete mailing address, and telephone number. Each page should have the principal author's name in the upper-left-hand corner. If there are multiple authors, the title page should indicate which author will handle correspondence and deliver the talk.

Send Papers to: Gerald L. Engel
P.O. Box 602 Gloucester Point, Virginia 23062

Papers for this conference were due January 15, 1979, however because of the lateness of this notice, Gerry Engel told us that he would accept papers up to February 15, 1979. This is an absolute deadline; papers received after this date cannot be considered.

CONFERENCE BACKGROUND

In recent years a variety of professional meetings have been held regarding computer education, computer uses in education, administrative computing in educational institutions, college and university computer center resources and services, and data processing. A number of these conferences have been scheduled during the summer months in order to attract individuals from colleges, universities, government agencies, and private businesses who would often combine attendance at such meetings with a summer holiday. With few exceptions, attendance at these meetings has been relatively low. More significantly with the fairly large number of such meetings annually scheduled, few individuals can attend more than one meeting per year. As a result, interaction between participants in the various professional groups has not often been achieved. In a survey conducted by the ACM Special Interest Group on Computer Uses in Education (SIGCUE) under the direction of Alfred Bork of the University of California-Irvine and Kent Morton of Dartmouth College, it was discovered that individuals who participate in these various professional groups felt that common efforts, while retaining some of the identity of the groups, would be worthwhile for a variety of reasons. Among those cited were the elimination of duplication of effort and the need for interaction on topics of common interest. In response to this expressed need, the Conference on Computers in Undergraduate Curricula (CCUC) Steering Committee, with the support of 11 other professional computer organizations, decided to organize a national computer conference—in lieu of CCUC/10—which would provide ample opportunity for the interprofessional exchange of ideas about educational computing. Thus, NECC came into being.

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Computerized Sports Predictions

Don Smith

An interesting application for home computing is forecasting the outcomes of sporting events. Since large sums of money are wagered on these outcomes, a great deal of effort goes into obtaining information and working out prediction strategies. Professional oddsmakers have entire staffs working to obtain the latest information on the teams. Computers have sometimes been used to keep track of the data and make predictions. The prediction algorithms can be very complex, taking into account much detailed information.

This article presents a sports prediction algorithm developed with the following goals in mind:

1. It should be simple enough for implementation on a small home computer.
2. It should require a minimum of data entry from week to week.
3. It should develop numerical ratings for each team so that the predicted point spread for a game is the difference in the ratings of the two teams involved.
4. It should "learn," adjusting team ratings as the season progresses.
5. It should consider the quality of opponents in making and adjusting its ratings.
6. It should consider home-team advantage.

Since the author is interested in professional football, and since there are a reasonable number of teams (28) all playing exclusively among themselves, NFL football seemed a likely test bed for the development of the prediction algorithm. The program listing shows the algorithm as applied to NFL football, implemented on the Tektronix 4051. The sample run shows the three output tables generated by the program for the fourth week of the 1977 NFL season. Table 1 gives the results for week 4, Table 2 lists the updated ratings of the 28 teams sorted in ratings order, and Table 3 lists the prediction for week 5.

The 1977 matchups are stored in a matrix M, where M(I,J) is the number of the opponent of team I in week J. Team numbers are as follows:

Don Smith, PhD., G519 Plaza Parkway #123, Ft. Worth, Texas 76116.

AFC		NFC
1. BALTIMORE		15. NEW YORK GIANTS
2. NEW ENGLAND		16. DALLAS
3. MIAMI	EAST	17. PHILADELPHIA
4. BUFFALO		18. ST. LOUIS
5. NEW YORK JETS		19. WASHINGTON
6. PITTSBURGH		20. CHICAGO
7. HOUSTON		21. GREEN BAY
8. CLEVELAND	CENTRAL	22. DETROIT
9. CINCINNATI		23. MINNESOTA
		24. TAMPA BAY
10. OAKLAND		25. ATLANTA
11. DENVER		26. NEW ORLEANS
12. KANSAS CITY	WEST	27. LOS ANGELES
13. SEATTLE		28. SAN FRANCISCO
14. SAN DIEGO		

NFL Team Numbers

If an element of M is negative, that number represents the home team. For example, M(1,3) = 4 means that Baltimore (1) plays Buffalo (4) the third week of the season at Baltimore. M(5,1) = -7 means that the New York Jets (5) play at Houston (-7) the first week. Typing the entire season of matchups into DATA statements is a little work, but it avoids having to enter the matchups each week. Note that each DATA statement (lines 140-410) gives the 14 opponents of a team for the 1977 season.

After the user enters the week number (I), the program reads the current team ratings into array E from tape, and adds the home advantage (F1) where applicable, to obtain array G. The "actual deltas," or point spreads, for week I are read into array D. For example, if Houston beat Buffalo by 10 points, D(7) would be 10, and D(4) would be -10. If Miami lost to New England by 16, then D(3) = -16 and D(2) = 16. The program computes the predicted point spread A1 in line 810 and compares it to the actual point spread, incrementing counter C when the prediction was correct. Note that the program predicts no ties — if a team is favored by only 0.01 points it is still the predicted winner. If the favored team wins, the prediction is counted as correct, even if the predicted point spread was wrong (as it usually will be). For example, in Table 1, even though the predicted point spread for Baltimore over Miami was 1.53, and the actual point spread was 17, the prediction is counted as correct.

The team ratings are adjusted in lines 880 and 890. Since this adjustment is the heart of the algorithm, it deserves some explanation. The "ratings adjustment equation" is

880 E(K1) = E(K1) + H * (M1 - A1)

where

- K1 = team index
- E = ratings array
- H = adjustment factor
- M1 = actual point spread of game, limited to ± N2
- A1 = predicted point spread

N2 is a maximum point spread for adjusting team ratings. M1 is calculated in line 790. This maximum spread is used because in a runaway game, beyond a certain number of points, the point spread is no longer significant.

The essence of line 880 is that if a team does better than expected, its rating is increased, and if it does worse than expected, its rating is decreased. The adjustment factor H is chosen large enough to make the algorithm sensitive to actual results, but not so large as to make the algorithm erratic.

This adjustment algorithm satisfies the six goals in the following ways:

1. It is simple.
2. It requires only actual point spreads from the games of the previous week as input.
3. The ratings automatically converge to numbers which yield predicted point spreads, since the diference between the predicted and the actual point spread drives the adjustment.
4. It learns. The program can be started with all teams equally rated at the beginning of a season, and it will learn which teams are good and which are bad.
5. It automatically considers the quality of the opposition. For example, if Tampa Bay lost to Pittsburgh by only one point, the algorithm would increase Tampa Bay's rating, and decrease Pittsburgh's rating.
6. It considers home-team advantage.

Three parameters in the program, F1 (home-advantage), H (adjustment factor), and N2 (maximum point spread) are given numerical values in lines 440 and 450. How were these values obtained? The 1976 NFL season schedule and results were put into a separate test program. The prediction algorithm was then cycled through all 14 games of the 1976 season for various values of F1, H and N2. At the beginning of each run, the ratings array E was set to 10, so all teams were initially considered equal. The values of F1, H and N2 were optimized to produce the highest percentage of correct predictions. The table below shows some typical parameter values and the resulting percentage of correct predictions.

PROGRAM LISTING

```
100 REM   - - -   NFL PREDICTION PROGRAM   - - -
110 REM                BY DON SMITH
120 REM --- PUT 1977 MATCHUPS INTO ARRAY M ---
130 DIM D(28),M(28,14),E(28),Y(28),G(28)
140 DATA -13,-5,4,3,-12,-2,6,19,-4,5,-11,-3,22,2
150 DATA 12,-8,-5,13,-14,1,5,4,-3,-4,17,-25,3,-1
160 DATA -4,-28,7,-1,5,13,14,-5,2,-9,-18,1,-2,4
170 DATA 3,-11,-1,5,25,8,-13,-2,1,2,-10,19,-5,-3
180 DATA -7,1,2,-4,-3,10,-2,3,13,-1,6,-26,4,-17
190 DATA 28,10,-8,-7,9,7,-1,-11,8,16,-5,13,-9,-14
200 DATA 5,-21,-3,6,8,-6,-9,20,-10,-13,12,11,-8,9
210 DATA -9,2,6,10,-7,-4,12,9,-6,-15,27,-14,7,-13
220 DATA 8,13,-14,-21,-6,11,7,-8,-23,3,15,-12,6,-7
230 DATA 14,-6,-12,-8,11,-5,-11,13,7,-14,4,-27,23,12
240 DATA 18,4,-13,12,-10,-9,10,6,-14,-12,1,-7,14,-16
250 DATA -2,14,10,-11,1,-14,-8,21,-20,11,-7,9,13,-10
260 DATA 1,-11,11,-2,24,-3,4,-10,-5,7,14,-6,-12,8
270 DATA -10,-12,9,-26,2,12,-3,-22,11,10,-13,8,-11,6
280 DATA 19,-16,-25,17,28,-19,-18,16,-24,8,-9,18,-17,20
290 DATA -23,15,24,-18,19,-17,22,-15,18,-6,-19,17,-28,11
300 DATA 24,-27,-22,-15,18,16,-19,26,19,-18,-2,-16,15,5
310 DATA -11,20,-19,16,-17,26,15,-23,-16,17,3,-15,19,-24
320 DATA -15,25,18,-24,-16,15,17,-1,-17,21,16,-4,-18,27
330 DATA 22,-18,26,27,-23,25,-21,-7,12,23,-22,-24,21,-15
340 DATA -26,7,-23,9,-22,-24,20,-12,27,-19,23,22,-20,28
350 DATA -20,26,17,-23,21,-28,-16,14,-25,24,20,-21,-1,23
360 DATA 16,-24,21,22,20,-27,-25,18,9,-20,-21,28,-10,-22
370 DATA -17,23,-16,19,-13,21,-28,-27,15,-22,25,20,-26,18
380 DATA 27,-19,15,-28,-4,-20,23,28,22,-26,-24,2,-27,21
390 DATA 21,-22,-20,14,-27,-18,27,-17,28,25,-28,5,24,-25
400 DATA -25,17,28,-20,26,23,-26,24,-21,-28,-8,10,25,-19
410 DATA -6,3,-27,25,-15,22,24,-25,-26,27,26,-23,16,-21
420 READ M
430 REM --- SET HOME ADVANTAGE,ADJUSTMENT
            FACTOR & MAX POINT SPREAD ---
440 DATA 1.5,0.05,20
450 READ F1,H,N2
460 PRINT "LWEEK NUMBER?  ";
470 INPUT I
480 IF I>1 THEN 530
490 PRINT "INITIALIZE TAPE DATA?  ";
500 INPUT Z$
510 IF Z$<>"Y" THEN 530
520 GOSUB 1620
530 A2=1977
540 REM --- READ CURRENT TEAM RATINGS FROM TAPE FILE ---
550 FIND 5
560 C=0
570 READ @33:E
580 PRINT "UPDATE BACK-UP DATA FILE?  ";
590 INPUT Z$
600 IF Z$<>"Y" THEN 630
610 FIND 6
620 WRITE @33:E
630 D=-9999
640 REM --- COMBINE HOME ADVANTAGE WITH RATING FOR EACH TEAM ---
650 FOR K1=1 TO 28
660 F=0
670 IF M(K1,I)<0 THEN 690
680 F=F1
690 G(K1)=E(K1)+F
700 NEXT K1
710 REM --- READ IN ACTUAL DELTAS FOR LATEST GAMES ---
720 FOR K1=1 TO 28
730 IF D(K1)<>-9999 THEN 900
740 PRINT "ENTER DELTA FOR ";
750 Z1=K1
```

The funny Ls and Js in PRINT statements are inserted for controlling the printer. Ls generate a top-of-page, and Js create line feeds.

This part of the program is designed for reading and writing the array E using a mass storage device. Since this feature varies greatly from one BASIC to another, look in your user's manual to find out how to load and save arrays on tape or disk.

F1	H	N2	% CORRECT FOR 1976
1.5	0.05	20	68.62
1.4	0.05	20	68.11
1.5	0.04	20	67.60
1.5	0.05	15	67.09

It was found that F1 = 1.5 points, H = 0.05, and N2 = 20 points are optimal. Interestingly, the optimization was also run over the first 6 games of the 1977 season, with the same results. This would seem to indicate a consistency in the dynamics of the National Football League.

```
760 GOSUB 1740
770 INPUT D(K1)
780 K=ABS(M(K1,I))
790 M1=D(K1) MIN N2 MAX -N2
800 D(K)=-D(K1)
810 A1=G(K1)-G(K)
820 Y(K1)=A1
830 Y(K)=-A1
840 REM --- COUNT THE NUMBER (C) OF CORRECT PREDICTIONS ---
850 IF SGN(D(K1))<>SGN(A1) THEN 880
860 C=C+1
870 REM --- ADJUST TEAM RATINGS ---
880 E(K1)=E(K1)+H*(M1-A1)
890 E(K)=E(K)+H*(A1-M1)
900 NEXT K1
910 REM --- PRINT 'RESULTS' TABLE ---
920 PRINT "L                RESULTS FOR WEEK ";I;" ";A2
930 PRINT USING "42X,FA":"JPRED    ACTJ"
940 FOR J=1 TO 28
950 IF Y(J)=1000 THEN 1090
960 M1=J
970 K=ABS(M(J,I))
980 IF M(J,I)<0 THEN 1010
990 M1=K
1000 K=J
1010 Z1=M1
1020 GOSUB 1740
1030 PRINT "AT  ";
1040 Z1=K
1050 GOSUB 1740
1060 PRINT USING "3D.2D,3X,3D":Y(M1),D(M1)
1070 Y(M1)=1000
1080 Y(K)=1000
1090 NEXT J
1100 PRINT USING "/3D.2D,S":C*100/14
1110 PRINT " % CORRECT FOR WEEK ";I
1120 COPY
1130 I=I+1
1140 REM --- PRINT NEW RATINGS TABLE ---
1150 PRINT "LAVERAGES AFTER WEEK ";I-1;"  -  ";A2;"JJ"
1160 PRINT "       TEAM              RATINGJ"
1170 Y=E
1180 FOR J=1 TO 28
1190 PRINT USING "2D,2X,S":J
1200 M1=1
1210 FOR K=1 TO 28
1220 IF Y(K)<=Y(M1) THEN 1240
1230 M1=K
1240 NEXT K
1250 Z1=M1
1260 GOSUB 1740
1270 PRINT USING "3D.2D":E(M1)
1280 Y(M1)=-1000
1290 NEXT J
1300 COPY
1310 IF I>14 THEN 1600
1320 REM --- PRINT PREDICTION TABLE ---
1330 PRINT "L          PREDICTION FOR WEEK ";I;", ";A2;"JJ"
1340 Y=0
1350 FOR J=1 TO 28
1360 IF Y(J)=1 THEN 1510
1370 M1=J
1380 K=ABS(M(J,I))
1390 IF M(J,I)<0 THEN 1420
1400 M1=K
1410 K=J
1420 Z1=M1
1430 GOSUB 1740
1440 PRINT "AT  ";
1450 Z1=K
1460 GOSUB 1740
1470 A1=E(M1)-E(K)-F1
1480 PRINT USING "3D.2D":A1
1490 Y(M1)=1
1500 Y(K)=1
1510 NEXT J
1520 COPY
1530 PRINT "UPDATE TAPE?  ";
1540 INPUT Z$
1550 IF Z$="Y" THEN 1580
1560 END
```

The MIN and MAX functions choose the greatest of least of two expressions. X MIN Y is X is X Y, and Y if X Y. For instance, 5 MAX 10 is 10, and 5 MIN 10 is 5.

PRINT USING also varies quite a bit from one BASIC to another, and some don't even have it. In this BASIC, 3D.2D means to print a number as three digits, then the decimal point, then two digits. 3X means to print three spaces. If you can't figure out how this works, then just use PRINT statements with TABs to adjust the output as shown in the sample run, or to suit your own preference.

Starting the 1977 season with a reasonable estimate for the team ratings, the program has predicted 73.5% of the games correctly through the first 10 weeks. The worst week was week 7 with 42.8% and the best was week 10 with 92.8%. No claim is made that this is better than human predictors can do, especially with more detailed information, but it seems pretty good for such a simple algorithm.

Note that although this prediction program was written specifically for NFL football, the basic algorithm could be applied just as easily to college football, baseball, basketball, hockey, etc. It is probably true, however, that the optimal parameter values and the prediction accuracies will be different for different sports.

For those who want to achieve higher prediction accuracies at the expense of increased program complexity and data requirements, many possible improvements could be explored. If many factors are considered, the computation of G could take the form

G(I) = N1 * F1 + N2 * F2 + ... + NK * FK

where K is the number of factors, the F's are the factors and the N's are weights. The N's would be found by optimization to produce the greatest possible per cent of correct predictions. The additional factors might include team standings, injuries to key players, the biorhythms of the players,...?

■

```
                RESULTS FOR WEEK 4 1977

                                                    PRED    ACT
MIAMI              AT  BALTIMORE                   -1.53    -17
SEATTLE            AT  NEW ENGLAND                -23.32    -31
NEW YORK JETS      AT  BUFFALO                      4.01      5
PITTSBURGH         AT  HOUSTON                      6.18    -17
OAKLAND            AT  CLEVELAND                    1.90     16
CINCINNATI         AT  GREEN BAY                    3.48     10
KANSAS CITY        AT  DENVER                     -17.41    -16
SAN DIEGO          AT  NEW ORLEANS                  6.43     14
PHILADELPHIA       AT  NEW YORK GIANTS              1.24     18
DALLAS             AT  ST. LOUIS                    4.22      6
WASHINGTON         AT  TAMPA BAY                    8.58     10
LOS ANGELES        AT  CHICAGO                     13.86     -1
DETROIT            AT  MINNESOTA                   -6.68     -7
ATLANTA            AT  SAN FRANCISCO                3.24      7

 85.71 % CORRECT FOR WEEK 4
```

TABLE 1. RESULTS

```
1570 REM --- WRITE NEW TEAM RATINGS TO TAPE FILE ---
1580 FIND 5
1590 WRITE @33:E
1600 END
1610 REM --- SUBROUTINE FOR INITIALIZING TEAM RATINGS ---
1620 PRINT "␣ENTER TEAM RATINGS␣"
1630 FOR Z1=1 TO 28
1640 GOSUB 1740
1650 INPUT E(Z1)
1660 NEXT Z1
1670 PRINT "ALL RIGHT?  ";
1680 INPUT Z$
1690 IF Z$="Y" THEN 1710
1700 GO TO 1620
1710 FIND 6
1720 WRITE @33:E
1730 RETURN
1740 REM --- SUBROUTINE FOR PRINTING TEAM NAMES ---
1750 GO TO Z1 OF 1790,1810,1830,1850,1870,1890,1910,1930,1950,1970,1990
1760 GO TO Z1-11 OF 2010,2030,2050,2070,2090,2110,2130,2150,2170,2190
1770 GO TO Z1-21 OF 2210,2230,2250,2270,2290,2310,2330
1780 RETURN
1790 PRINT "BALTIMORE          ";
1800 RETURN
1810 PRINT "NEW ENGLAND        ";
1820 RETURN
1830 PRINT "MIAMI              ";
1840 RETURN
1850 PRINT "BUFFALO            ";
1860 RETURN
1870 PRINT "NEW YORK JETS      ";
1880 RETURN
1890 PRINT "PITTSBURGH         ";
1900 RETURN
1910 PRINT "HOUSTON            ";
1920 RETURN
1930 PRINT "CLEVELAND          ";
1940 RETURN
1950 PRINT "CINCINNATI         ";
1960 RETURN
1970 PRINT "OAKLAND            ";
1980 RETURN
1990 PRINT "DENVER             ";
2000 RETURN
2010 PRINT "KANSAS CITY        ";
2020 RETURN
2030 PRINT "SEATTLE            ";
2040 RETURN
2050 PRINT "SAN DIEGO          ";
2060 RETURN
2070 PRINT "NEW YORK GIANTS    ";
2080 RETURN
2090 PRINT "DALLAS             ";
2100 RETURN
2110 PRINT "PHILADELPHIA       ";
2120 RETURN
2130 PRINT "ST. LOUIS          ";
2140 RETURN
2150 PRINT "WASHINGTON         ";
2160 RETURN
2170 PRINT "CHICAGO            ";
2180 RETURN
2190 PRINT "GREEN BAY          ";
2200 RETURN
2210 PRINT "DETROIT            ";
2220 RETURN
2230 PRINT "MINNESOTA          ";
2240 RETURN
2250 PRINT "TAMPA BAY          ";
2260 RETURN
2270 PRINT "ATLANTA            ";
2280 RETURN
2290 PRINT "NEW ORLEANS        ";
2300 RETURN
2310 PRINT "LOS ANGELES        ";
2320 RETURN
2330 PRINT "SAN FRANCISCO      ";
2340 RETURN
```

AVERAGES AFTER WEEK 4 - 1977

	TEAM	RATING
1	DENVER	30.15
2	LOS ANGELES	24.88
3	NEW ENGLAND	24.49
4	DALLAS	23.95
5	OAKLAND	23.13
6	PITTSBURGH	22.61
7	BALTIMORE	19.37
8	SAN DIEGO	19.13
9	CLEVELAND	18.32
10	ST. LOUIS	18.05
11	MIAMI	17.80
12	ATLANTA	17.26
13	HOUSTON	17.25
14	NEW YORK JETS	15.86
15	KANSAS CITY	14.38
16	CINCINNATI	14.18
17	PHILADELPHIA	13.45
18	SAN FRANCISCO	12.14
19	WASHINGTON	11.43
20	CHICAGO	11.00
21	NEW ORLEANS	10.44
22	MINNESOTA	10.39
23	BUFFALO	10.25
24	NEW YORK GIANTS	9.03
25	GREEN BAY	8.54
26	DETROIT	5.17
27	SEATTLE	3.01
28	TAMPA BAY	1.21

TABLE 2. TEAM RATINGS

PREDICTION FOR WEEK 5, 1977

BALTIMORE	AT	KANSAS CITY	3.49
NEW ENGLAND	AT	SAN DIEGO	3.87
NEW YORK JETS	AT	MIAMI	-3.44
ATLANTA	AT	BUFFALO	5.51
CINCINNATI	AT	PITTSBURGH	-9.94
CLEVELAND	AT	HOUSTON	-0.43
DENVER	AT	OAKLAND	5.52
TAMPA BAY	AT	SEATTLE	-3.30
SAN FRANCISCO	AT	NEW YORK GIANTS	1.61
WASHINGTON	AT	DALLAS	-14.02
ST. LOUIS	AT	PHILADELPHIA	3.10
CHICAGO	AT	MINNESOTA	-0.88
GREEN BAY	AT	DETROIT	1.87
NEW ORLEANS	AT	LOS ANGELES	-15.94

TABLE 3. PREDICTIONS

Analyzing statistical data is possible with TRS-80 Level I Basic or other computers with single-dimensional arrays.

Multiple Regression Analysis — Simplified

Dr. David M. Chereb

While the LEVEL I BASIC from Radio Shack is limited, it does have enough capability to handle some rather advanced programs. The example included here (and listed in Figure 4) is a multiple regression routine. The key to the program is the single allowable vector A(n). The length of this vector is limited only by memory size (memory/4).

Because multi-dimensioned arrays are not supported by LEVEL I, special techniques are needed to simulate the N by K matrix which is the basic starting point for the multiple regression routine. Also since the program uses a modified Gauss-Jordan elimination technique, there are many sections which use nested FOR loops. Doing all this with a single A(n) vector brings one closer to understanding the nature of insanity. The basic technique is to manipulate the vector as if it *were* an N by K matrix, letting special counters do all the hard work of locating the correct numbers (see Figure 1).

Multiple Regression

The multiple regression program finds the statistical relationship between the K independent variables and a single dependent variable. What does that mean? It means that the statistical technique of multiple regression will give us the *best* equation possible. There are certain restrictions which must be met for this to be true. For our needs, we can assume these conditions are met in most practical situations. An example of a multiple regression problem is shown in Figures 2 and 3.

In the example shown in Figures 2 and 3, United States imports are analyzed. The variable to be explained is U.S. imports in constant 1972 dollars (the dependent variable). The explanatory variables are

1) the change in Gross National Product,
2) the size of the labor force, and
3) a variable representing time.

FIGURE 1

MATRIX MANIPULATION WITH THE A(n) VECTOR

Let's suppose we wanted to add two matrices B and C and call the resultant matrix D. The matrices must be of the same size to do this, so let's say they are both 4 by 3 (4 rows by 3 columns).

$$B = \begin{vmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 3 \\ 1 & 3 & 1 \end{vmatrix} \qquad C = \begin{vmatrix} 1 & 3 & 4 \\ 0 & 1 & 0 \\ 2 & 0 & 1 \\ 1 & 2 & 0 \end{vmatrix}$$

If D = B + C then

$$D = \begin{vmatrix} 2 & 3 & 5 \\ 1 & 2 & 0 \\ 3 & 2 & 4 \\ 2 & 5 & 1 \end{vmatrix}$$

For LEVEL I BASIC this is done by:

Assume A(1) ..... A(12) = B matrix
A(13)..... A(24) = C matrix
A(25)..... A(36) = D matrix

$$\text{Then } B = \begin{vmatrix} A(1) & A(5) & A(9) \\ A(2) & A(6) & A(10) \\ A(3) & A(7) & A(11) \\ A(4) & A(8) & A(12) \end{vmatrix} = \begin{vmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 3 \\ 1 & 3 & 1 \end{vmatrix}$$

The routine is:

```
FOR J=1 TO 3
    FOR I=1 TO 4
                    K=I+(J-1)*4
                    L=12+I+(J-1)*4
                    M=24+I+(J-1)*4
                    A(M)=A(K)+A(L)

    NEXT I
NEXT J
```

Notice that when J=1 then K=I, L=12+I and M=24+I so that the data is allocated to the correct element of the A(n) vector. While there are other ways to do this problem the one presented here closely simulates a two dimensional array program and can be easily modified to handle all forms of matrix operations with any number of columns and rows.

Dr. David M. Chereb, 4005 Locust Ave., Long Beach, CA 90807.

FIGURE 2

MULTIPLE REGRESSION INPUTS

Time Period: 1965 to 1974 by quarter—40 observations

Dependent Variable: U.S. imports in billions of 1972 dollars

Independent Variables (Chosen by author, based upon experience):

1) Change in Gross National Product in 1972 $ from the previous quarter * 10
2) U.S. labor force in millions
3) Time variable: 1000/time, where time=1 in 1957 first quarter and advances by one in each quarter.

These variables were chosen because they are the important variables which affect imports. The first variable is included because rapid growth in U.S. production usually causes imports to accelerate. The labor force variable accounts for the gross level of imports. If the labor force is only 50 million people instead of 100 million, then imports would be much less. The time variable represents a non-linear response over time for U.S. imports. A *negative* coefficient for this variable would mean that imports increase over time even if the GNP and the labor force did not increase. This reflects the generally increasing interdependence of national economies over time (the import share in GNP has doubled in the last 9 years).

The results reveal that all of the independent variables are important (t values over + 2) and that an increase in the labor force by one million people will cause imports to increase by $1.43286 billion. To get an estimate, values for all the independent variables are entered into the equation. If the values for the independent variables are

1) GNP-1 * 10 = $101 billion,
2) Labor Force = 84.2 million, and
3) 1000/Time = 20 (1969:2)

then next quarter the level of imports is expected to be $62.18 billion (at an annualized rate).

We must remember that this is only an estimate. The higher the t values and the coefficient of determination (the R squared adjusted), the more confidence we usually have in the validity of the equation. In this case the estimates of the next period's imports are accurate to within + $3.8 billion (90% confidence interval).

Since the LEVEL I BASIC has only six significant digits, there are roundoff problems. For most uses the estimated coefficients from the program are accurate to 3 or 4 places. Given our current knowledge about economic relationships, we rarely need more than three places of accuracy.

FIGURE 3

MULTIPLE REGRESSION RESULTS

Equation to be estimated:

Imports = B0 + B1 * GNP - 1 + B2 * Labor Force + B3 * 1000/Time
(LF) (T)

= -32.6641 + .0118321 * GNP - 1 + 1.43286 * LF - 1.34998 * 1000/T

Std. Errs	(33.4041)	(.0038404)	(.314984)	(.333134)
t Values	(-.977845)	(3.0809)	(4.549)	(-4/05235)

R^2 = .974
R^2(adj.) = .972
S.E. = 2.2594

Multiple regression uses the data to solve for the unknowns: B0, B1, B2, B3.

The actual technique is to minimize the sum of squared errors of the actual data points of the dependent variable and the estimated data points from the regression equation (i.e. $y-\hat{y}$). There are many textbooks which explain the details of regression analysis.

The Basic program uses 6K of memory with each data point adding 4 more bytes. For the example shown, less than 9K of memory is required. To execute this problem takes about 50 seconds. While this seems long in comparison to a large mainframe computer, it is generally acceptable since this is not a problem that is run many times with the same data. Once the equation has been estimated, the regression routine has done its job. From thereon U.S. imports can be easily estimated on any calculator using the equation in Figure 3. The only time the regression routine need be used again on *this* problem is when new information leads you to believe that forecasting accuracy can be improved by re-estimating the equation using the new information (usually more data or more variables). In a business forecasting environment, even higher accuracy would be the goal.

The Future

Radio Shack's LEVEL II BASIC allows multi-dimensional arrays, transcendental routines and double precision variables. This will make statistical analysis much easier. It will be interesting to compare the execution speed of a multiple regression routine for LEVEL II versus the LEVEL I program shown here. In any event now that you've seen the power of the A(n) vector, perhaps you'll shun all multi-dimensional arrays in the future and stick with A(n). If you do, don't count me in with you. ■

```
10 REM*************************************************
20 REM***  MULTIPLE REGRESSION ANALYSIS          ***
30 REM***     ( LEAST SQUARES ANALYSIS )         ***
40 REM***   BY   DAVID M. CHEREB  5/5/78         ***
50 REM*************************************************
52  REM
53 CLS : PRINT:PRINT TAB(10);"MULTIPLE REGRESSION ANALYSIS"
55  REM  *** DATA FOR CONSUMPTION FUNCTION  ***
56  REM  *** VAR 1=CONSTANT  2=DIS. INCOME  3=CONSUMPTION(-1) ***
58  DATA "U. S.  CONSUMP. "
60  DATA 1,1,1,1,1,1,1,1,1,1
62  DATA 1,1,1,1,1,1,1,1,1,1
64  DATA 2.862,2.877,2.910,  2.911,2.946,2.961,2.933
66  DATA 2.913,2.926,2.999,3.021,  3.059,3.125,3.113,3.132
68  DATA 3.154,3.203,3.210,3.201
70  DATA 2.632,2.637,2.634,2.669,  2.689,2.704,2.734,2.721
72  DATA 2.689,2.709,2.744,2.787,  2.838,2.897,2.908,2.928
74  DATA 2.954,2.995,2.986
76  REM  *** DEP.  VAR  (CONSUMPTION) IS NEXT  ***
78  DATA 2.637,2.634,2.669,  2.689,2.704,2.734,2.721
80  DATA 2.689,2.709,2.744,2.787,  2.838,2.897,2.908,2.928
82  DATA 2.954,2.995,2.986,2.996
90  PRINT : PRINT"THIS PROGRAM ESTIMATES A LEAST SQUARES EQUATION "
92  PRINT"OF THE FORM  Y = XB     WHERE  Y = (N * 1) VECTOR"
94  PRINT"                               X = (N * K) MATRIX "
96  PRINT"                               B = (K * 1) VECTOR"
98 PRINT" Y = DEPENDENT VAR.     X = INDEPENDENT VAR. "
101  REM
102  PRINT" N= NUMBER OF OBSERVATIONS   K= NUMBER OF INDEPENDENT VAR. "
103  PRINT:PRINT"A SAMPLE PROBLEM IS INCLUDED  TO SEE HOW THE PROBLEM WORKS"
104  PRINT"THE EXAMPLE HAS 19 OBS.  & 2 INDEP.  VAR. "
105  INPUT"DATA SOURCE : 1 = KEYBOARD   2 = EXAMPLE PROBLEM ";B
107  IF B=2 THEN N=19 : K=2 :GOTO 110
108  INPUT"INPUT  N  AND  K  ";N,K
109  INPUT"INPUT NAME OF DEPENDENT VAR. (UP TO 16 CHAR. )";A$
110  FOR I=1 TO 2*N*(K+2)+4*K*K:A(I)=0:NEXTI
111  IF B=2 THEN READ A$
112  IF B=2 THEN 120
```

MULTIPLE LEAST SQUARES ANALYSIS PROGRAM

This program computes the least squares coefficients for the following equation:

Given Y = XB

where Y=Nx1 vector of N observations of the dependent variable
X=NxK matrix of N observations of K independent variables
B=Kx1 vector of coefficients

Then the least squares solution is:

$$\hat{B} = (X'X)^{-1}(X'Y)$$

The specifics of the program are:

1) Will take K independent variables (where K is limited by system memory not program)
2) Will take N observations (where N is limited by system memory not program)
3) Allows the user to input the name of the dependent variable
4) A constant is assumed to be included in the equation and is automatically read into the A() vector (when program asks for K do not count the constant as one of the indep. var)
5) The program displays the $(X'X)^{-1}$ matrix. This helps in analyzing multicolinearity.
6) A complete example of a regression analysis is included in the program for examining the outputs. The data is United States quarterly figures from 1956:I to 1960:IV. The data is in dollars($x10^{11}$). The estimated equation is a consumption function which estimates consumer consumption using income(disposable) and consumption from the previous period as independent variables. The resulting estimated equation should be

$$C_t = -.34 + .76Y_t + .30C_{t-1}$$
$$(.082)\ (.079) \text{ — standard errors)}$$
$$(9.27)\ (3.80) \text{ — t-value}$$

This equation was reported by Zvi Griliches, et al., in the July 1962 *Econometrica* journal.

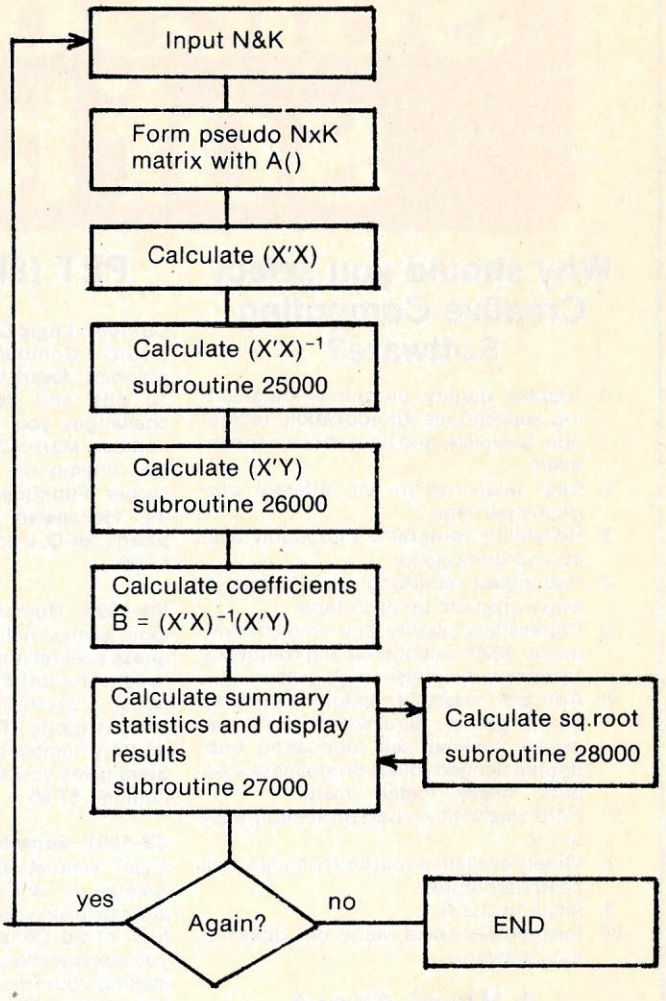
The TRS-80 results from the current program are acceptable given the difficulty of the problem (19 obs. & 3 coeff. to estimate and a 3x3 matrix inversion)

7) The outputs from the route are:
   a) name of dependent variable
   b) least squares coefficients (indep.var.)
   c) standard errors of coefficients (est.of σB)
   d) t-value of coefficients
   e) R-squared (coefficient of determination)
   f) R-squared (adj. for degrees of freedom)
   g) standard error of equation) est.of σ)

```
114  FOR J=2 TO K+1
116  PRINT"VAR # ";J-1 :GOTO 140
120  FOR J=1 TO K+1
130  PRINT"VAR # ";J
140  FOR I=1 TO N
142  IF B=2 THEN READ A(I+(J-1)*N+N):GOTO 180
160    INPUT"INPUT OBS.   ";A(I+(J-1)*N+N)
170   A(I+N)=1
180  NEXTI
200  NEXTJ
220  PRINT" NOW INPUT Y "
230  FOR I=1 TO N
232  IF B=2 THEN READ A(I):GOTO 250
240  INPUT A(I)
250  NEXT I
400  CLS
500  PRINT:PRINT" COMPUTING  X'X MATRIX ELEMENT # "
600  REM  ***
690  G=0
695  K=K+1
700  FOR H=1 TO K
800    FOR J=1 TO K
810      G=G+1
820      PRINT@ 95,G
900       FOR I=1 TO N
1000         L=H*N+I
1100         P=J*N+I
1200          Q=K*N+G+N
1300         A(Q)=A(L)*A(P)+A(Q)
1400       NEXTI
1500   NEXTJ
1600  NEXTH
1700  REM
1800  CLS
3020   CLS
3030  PRINT@ 0," INVERTING MATRIX          J ="
3100  GOSUB 25000
3200  GOSUB 26000
3210  REM
3220  REM  ****************************************
3230  REM  *  B-HAT FROM  (X'X)INV. & (X'Y)       *
3240  REM  ****************************************
3245  REM
3247  CLS
3250  PRINT:PRINT"THE DEPENDENT VAR. = ";A$
3260  G=0
3270  FOR J=1 TO R
3300    G=G+1
3310    FOR I=1 TO R
3320      L=N*(R+1)+R*R+I+(J-1)*R
3330      P=N*(R+1)+R*R*2+I
3340      Q=N*(R+1)+R*R*2+1+(R-1)+G
3400      A(Q)=A(L)*A(P)+A(Q)
3410    NEXT I
3600  NEXT J
4000  REM
4010  REM  **** GOTO SUB.  FOR SUMMARY STATISTICS ****
4020  GOSUB 27000
4030  REM
4940  IF B<>2 THEN 9990
9990  PRINT : INPUT"AGAIN (TYPE 1 ELSE 0)";B
9992  IF B=1 THEN 101
9999  END
25000  REM  ************************************
25002  REM  *  INVERSE BY GAUSS-JORDAN METHOD  *
25004  REM  ************************************
25006   REM
25010   REM  **  INPUT IS A  (K,K) MATRIX   OF  X'X  **
25020   REM  **  STARTING POINT OF MATRIX IS N*(K+1)  **
25110   R=K
25120  FOR J=1+N*(R+1) TO R+N*(R+1)
25150     M=R*R+J+(J-(N*(R+1))-1)*R
25160       A(M)=1
25170  NEXT J
25175  REM
25180  REM  ***  INVERT MATRIX  ***
25190  REM
25210  REM
25220  REM  ****  BIG LOOP STARTS ****
25230  REM
25235  G=0
25240  FOR J=1+N*(R+1) TO R+N*(R+1)
25242     G=G+1 : PRINT@ 29,G
25250    FOR I=J TO R+N*(R+1)
25260      H=I+(J-(N*(R+1))-1)*R
25270      IF A(H) <> 0 THEN 25310
25280    NEXT I
25290    PRINT:PRINT"SINGULAR MATRIX  -  CANNOT BE INVERTED "
25300    GOTO 9990
25310    FOR K=1+N*(R+1) TO R+N*(R+1)
25320      M=K+(J-(N*(R+1))-1)*R
25330      S=A(M)
25340      V=K+(I-(N*(R+1))-1)*R
25350      A(M)=A(V)
25360      A(V)=S
25370      S=A(M+R*R)
25380      A(M+R*R)=A(V+R*R)
25390      A(V+R*R)=S
25400    NEXT K
25410    P=J+(J-(N*(R+1))-1)*R
25420    T=1/A(P)
```

```
25430     FOR K=1+N*(R+1) TO R+N*(R+1)
25440       M=K+(J-(N*(R+1))-1)*R
25450       A(M)=T*A(M)
25455       A(M+R*R)=T*A(M+R*R)
25460     NEXT K
25470     FOR L=1+N*(R+1) TO R+N*(R+1)
25480       IF L=J THEN 25570
25490       M=J+(L-(N*(R+1))-1)*R
25500       T=-A(M)
25510       FOR K=1+N*(R+1) TO R+N*(R+1)
25520         V=K+(L-(N*(R+1))-1)*R
25530         Q=K+(J-(N*(R+1))-1)*R
25540         A(V)=A(V)+T*A(Q)
25550         A(V+R*R)=A(V+R*R)+T*A(Q+R*R)
25560       NEXT K
25570     NEXT L
25580   NEXT J
25590   REM
25600   REM ***  PRINT RESULTANT MATRIX  ***
25610   REM
25615   PRINT:PRINT"  (X'X) INVERSE IS : "
25620   FOR I=1+N*(R+1) TO R+N*(R+1)
25630      FOR J=1+N*(R+1) TO R+N*(R+1)
25640     L=J+(I-(N*(R+1))-1)*R+R*R
25650        PRINT A(L);"  ";
25660     NEXT J
25670     PRINT
25680   NEXT I
25700 INPUT"PRESS ENTER TO CONTINUE";Q
25990      RETURN
26000   REM
26100   REM  ********************************************
26120   REM  *  SUBROUTINE FOR COMPUTING X'Y            *
26130   REM  ********************************************
26140    REM
26200    G=0
26210    FOR J=1 TO R
26220      G=G+1
26225       FOR I=1 TO N
26230        L=J*N+I
26240        P=I
26250        Q=(R+1)*(R+N)+(R-1)*R+G
26260        A(Q)=A(L)*A(P)+A(Q)
26270      NEXT I
26280    NEXT J
26990   RETURN
27000   REM
27010   REM  ****************************************************
27020   REM  *  SUBROUTINE FOR COMPUTING LS SUMMARY STATS  *
27030    REM  ****************************************************
27040    REM
27100    REM  ***  R SQR.  ***
27105   K=R : S=0
27110    FOR I=1 TO N
27120      S=S+A(I)
27130    NEXT I
27140    M=S/N
27154    V=0:S=0
27160    FOR I=1 TO N
27178       Y=0
27180       FOR J=1 TO K
27184         D=N+I+(J-1)*N
27186         C=N*(K+1)+K*K*2+K+J
27200         Y=Y + A(C)*A(D)
27210     NEXT J
27220         E=A(I) - Y
27240         E=E*E
27250         S=S+E
27260         T=A(I)-M
27270         T=T*T
27280         V=V+T
27290      NEXT I
27300       R=1 - (S/V)
27302       S=S/(N-K)
27340   REM
27342   PRINT
27345   PRINT"    LS COEFF.        STD. ERROR        T-VALUE"
27347   PRINT"  -------------   -------------     ----------"
27350   FOR I=1 TO K
27360      Q=N*(K+1)+K*K+(I-1)*K + I
27370       L=N*(K+1)+K*K*2+K + I
27400       PRINT"B(";I-1;") = ";A(L),
27402       X=S*A(Q) : GOSUB 28100
27404       PRINTY,
27406       PRINTA(L)/Y
27410   NEXT I
27430   PRINT : PRINT"R-SQR =";INT(R*1000+.5)/1000
27432   R=1-(1-R)*(N-1)/(N-K)
27440   PRINT"R-SQR (ADJ) = ";INT(R*1000+.5)/1000
27450   X=S : GOSUB 28100
27460   PRINT"STD. ERROR = ";Y
27990    RETURN
28000   REM
28010   REM  ****************************************
28020   REM  * SUB FOR SQUARE ROOT  -  X IN  Y OUT  *
28030   REM  ****************************************
28040   REM
28100   Y=X/2 : Z=0
28110   W=(X/Y-Y)/2
28120    IF (W=0) + (W=Z) THEN RETURN
28130   Y=Y+W : Z=W :GOTO 28110
```

8) The program proceeds as follows:



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CS-1005. Graphics Games-2. Six favorite games. **LEM,** lunar lander with a graphic display and optional auto-pilot. **Nuclear Reaction,** a game of skill for two players. **Artillery,** in which two players shoot it out over computer-generated terrain. **Bounce** traces the path of a ball bouncing around the screen. **Checkers,** with graphic display, from our *BASIC Games* book. **Dodgem,** try to outmaneuver another player or the computer to get your pieces across the board first. $7.95.

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CS-4001. Space Games-1. Four color-graphics programs for your Apple, including **Rocket Pilot** an advanced lunar lander simulation in which you guide your spacecraft over the mountain to a safe landing on the opposite side. In **Saucer Invasion**, you protect the earth by shooting down the alien invasion fleet with your missile launcher. In **Star Wars**, you line up the Tie fighters in your sights and fire before they get away. **Dynamic Bouncer** is a color graphics demonstration program for your Apple which fills the screen with colored walls that appear and disappear at random, while a ball bounces around within. $7.95.

CS-4002. Sports Games-1. Four exciting graphics games. Includes an amazing **Baseball** game for two players who control infielders and outfielders, type of pitch, and the swing of the bat. Even has sacrifices, double plays, and home runs. **Horse Race** allows up to eleven players to bet on the outcome of a horse race. **Slalom** challenges you to ski through the gates in a minimum time. In **Darts** you try to throw your darts as close to the bullseye as possible by controlling the game paddles. $7.95.

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CS-5001. Graphics Games-2. (6 Games). LEM — lunar lander with display and optional auto pilot. **Nuclear Reaction** — two players bombard an atom with protons and electrons. **Pie Lob** — two players lob pies at each other over a sand castle. **Bounce** traces the path of a bouncing ball. **Checkers** — beginners game. **Dodgem** — try to get your pieces across the board first. $7.95.

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CS-6001. Graphic Games-3 (4 Games). In **Tank Attack** seek and destroy enemy guns hidden among houses and trees before they get you. **Dodgem** — try to get your pieces across the board first. **Free for All** — airplane, ship, and submarine vie for each other. **Hidden Maze** — find your way through an invisible maze. $7.95.

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Radio Shack TRS-80 Software

CS-2001. TRS-80 4k Level I Games-1. Battling **Deathstars,** an exciting two player realtime graphics game. **Hangman** challenges you to guess the computer's word before you're hung. **Lunar Lander** in which you try to land safely on the moon. Kid's **Math Race** teaches simple arithmetic. Or play **checkers** against your TRS-80. $7.95.

16K Level II Tapes

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Another new game from Creative Computing....

Gold Mine

Royce A. Jones

Have you ever wanted to own your own gold mine? Well, now you can, although it unfortunately exists only in a world inside your computer. Gold Mine is a video game written in DEC RSTS BASIC, but it can be converted to other BASICs without too much difficulty. The object of the game is to mine as much gold as possible within one year. On each turn you can move to a new location and mine if there's ore. Mining takes a day for each position, and movement occurs at the rate of five positions per day. See the game itself for more instructions.

Conversion Hints

The version presented here is set up for a CRT display, but it could be modified for a microcomputer with video display. The function defined at line 20 moves the cursor to a specified X-Y location, and the strings set up in line 30 perform various cursor control functions as explained in the program remarks. To convert these, you're just going to have to examine how they're used in the program, and figure out how to do the same thing on your own machine.

Notice that line numbers aren't present on every program line. You can insert line numbers as you wish, but be careful not to clobber any that are used later in the listing. Multiple statements are separated with a backslash. Randomize is not needed in most BASICs. Remarks are sometimes indicated with an exclamation mark—use REM if you want to be traditional.

Variables followed by a % sign are integers. If you don't have integer variables, just forget the % signs and everything will still work.

The funny CVT$$ function down in line 40 converts lower case to upper case. It's also used in line 700.

MAT X=ZER, in line 400, sets all the elements of the array to zero. You can do this with FOR loops, too.

GOTO...IF is a kind of backwards IF...THEN statement. A very tricky form of it is used in line 760, which can be expanded into:

```
FOR T1 = 1 to 4
IFMID$(K$,T1,1)=LEFT$(A$,1)THEN810
NEXT T1
```

SLEEP just kills time for a specified number of seconds. Use a long FOR loop if you want.

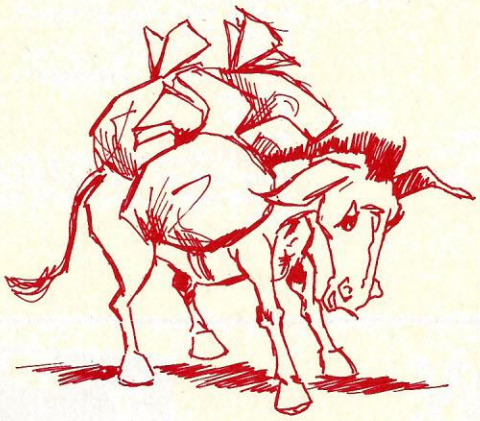
A data file on disk keeps track of the gold mining record, and is updated if necessary. If you have no disk, just skip over this part of the program (starting in line 1210). Otherwise, modify the disk I/O statements to read and update the disk file. For users of Microsoft BASIC, note that because of FOR loop conflicts, you must change the inner loop index in the section of code beginning with line 600. Changing T1 to T2 here will work correctly.

It is possible to convert this game to a printing terminal (we tried it) but it's certainly better with video. You'll have to scale the game down a bit to make it work on a PET or Apple, because the display is 61 characters wide, and the PET and Apple are only 40 characters. Users of TRS-80s, ADM-3 terminals, Sols, and other miscellaneous video displays with at least 64 character widths should find conversion easier.

```
10!     ****************************************
        *** COPYRIGHT 1976 BY ROYCE A. JONES  ***
        ****************************************
20      Def FNP$(X%,Y%)=Chr$(155%)+"Y"+Chr$(Y%+31%)+Chr$(X%+31%)
        ! Construct a string that leaves cursor at X%,Y%

30      C1$=Chr$(155%)+"H"\
        C2$=C1$+Chr$(155%)+"J"\
        C3$=Chr$(155%)+"A"\
        C4$=Chr$(155%)+"K"
        ! Make a home to 1,1 string and
        ! Clear screen and leave cursor at 1,1
        ! String to perform a reverse line feed
        ! String to kill remaining characters on the line
```

```
40      Randomize\
        Open "KB:" For Input as File 1%\
        Dim X%(10,61)\
        Print C2$;\
        Print "I've been a miner for a heart of sold, and I'm settin' old."\
        Print Tab (40);"--- Neil Young ---"\
        Print\
        Input "Instructions";K$\
        Goto 400 If Left(Cvt$$(K$,-1%),1)="N"\
        Print "Throughout mankind's history sold has been the magic metal."\
        Print "Gold has been prized by nearly every civilization. Now is"\
        Print "your chance to have your own sold mine. You have one year"\
        Print "to mine all the sold you can. The most your mine is worth"\
        Print "is one million dollars! But you must mine it. Your mine"\
        Print "contains 100 veins of sold. Each vein is worth $10000. To"\
        Print "start with your mine has just one vertical shaft. You"\
        Print "must enlarge on this by mining. It takes one day to mine"\
        Print "one position, whether it contains ore or not. If the positions"\
        Print "have already been mined you can move 5 positions in one day."\
        Print "You can move in four directions: up, down, left, and"\
        Print "right. To move specify the first letter of the direction you"\
        Print "wish to move and then the number of positions to move. For"\
        Print "example, two positions up would be U2, 3 positions right"\
        Print "would be R3, and so on. You can move as many positions as you want
        Print "in one direction except that you cannot go past the border"\
        Print "of the mine. If you try to you will be stopped at the border"\
        Print "and illegal move will be typed out. You can then move from"\
        Print "there on your next turn. If you wish to see the map of the"\
        Print "mine type in the letter M for your move. Each move takes"\
        Print "one day except for printing the map, which takes no days."\
        Print "On the map each level in the mine is a different letter, (A-J)."\
        Print "You are the miner and are represented by the letter M."\
        Print "You begin at the top of the shaft. All sold veins are shown"\
        Print "as *."\
        Print\
        Print
400     Mat X%=Zer\
        D,M=0\
        K$="UDLR"\
        L$="ABCDEFGHIJ"\
        X%[T%,31%]=1% For T%=1 to 10\
        X%[1%,31]=3\
        X1%=31\
        Y1%=1\
        For T%=1 to 100
510       Y%=Int(Rnd*10)+1
520       X%=Int(Rnd*61)+1\
          Goto 520 If X%=31%\
          Goto 510 If X%[Y%,X%]>0%\
          X%[Y%,X%]=2\
        Next T%
570     Print C2$;
590     Print C1$;
600     For T%=1 to 10\
          For T1%=1 to 61\
            On X%[T%,T1%]+1 Goto 680, 630, 650, 670
630         Print Tab (T1%);Mid(L$,T%,1%);\
            Goto 680
650         Print Tab (T1%);"*";\
            Goto 680
670         Print Tab (T1%);"M";
680       Next T1%\
          Print\
        Next T%
700     Gosub 1580\
        Print ".  Move: ";C4$;\
        Input Line #1%, A$\
        A$=Cvt$$(A$,-1%)\
        If Left(A$,1)="M" Goto 570
        ! ***   MINE OR MOVE   ***
760     Goto 810 If Mid(K$,T1%,1%)=Left(A$,1) For T1%=1% to 4%\
        Print FNP$(1,12%);\
        Print "Type either D, L, M, R or U followed by a number"\
        Sleep 10%\
        Print C3$+C4$;\
        Goto 700
790     Print FNP$(1%,12%);\
        Print "Boundry reached.";\
        Sleep 4%\
        Print Chr$(13%)+C4$;\
        Goto 700
810     N=Val(Mid(A$,2,3))\
        X9%=X1%+1%\
        Y9%=Y1%\
        Z$=Mid(L$,Y9%,1%)\
        For X%=1 to N\
          On T1% Goto 840, 900, 960, 1020
840       Y1%=Y1%-1%\
          Goto 880 If Y1%>0%\
          Y1%=Y1%+1%\
          Goto 790
880       X%[Y1%+1%,X1%]=1%\
          Goto 1070
```



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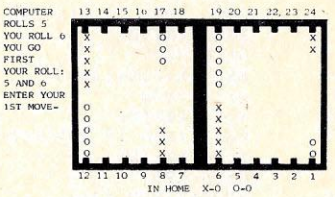
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```
900       Y1%=Y1%+1%\
          Goto 940 If Y1%<11%\
          Y1%=Y1%-1%\
          Goto 790
940       X%[Y1%-1%,X1%]=1%\
          Goto 1070
960       X1%=X1%-1%\
          Goto 1000 If X1%>0%\
          X1%=X1%+1%\
          Goto 790
1000      X%[Y1%,X1%+1]=1%\
          Goto 1070
1020      X1%=X1%+1%\
          Goto 1060 If X1%<62%\
          X1%=X1%-1%\
          Goto 790
1060      X%[Y1%,X1%-1]=1
1070      If X%[Y1%,X1%]=1 Goto 1140
1080      D=D+1\
          Goto 1210 If D>365.24\
          Goto 1160 If X%[Y1%,X1%]=0%\
          M=M+10000\
          Goto 1450 If M=1000000.\
          Goto 1160
1140      D=D+.2\
          If D>365.24 Goto 1210
1160      X%[Y1%,X1%]=3\
          Print FNP$(X9%,Y9%);Z$;\
          X9%=X1%+1%\
          Y9%=Y1%\
          Z$=Mid(L$,Y9%,1%)\
          Print FNP$(X9%,Y9%);"M";\
          Gosub 1580\
        Next X%\
        D=D+1\
        If D<365.24 Then
           Print FNP$(1%,11%);\
           Goto 700
1210    Gosub 1580\
        Print FNP$(1%,15%);\
        Print "Your year is up and you
           have mined $";M;" of gold."\
        Open "(1,6)GOLD.DAT" as File 2%\
        Gosub 1530\
        Goto 1400 If C>M\
        Goto 1380 If C=M\
        D=365.24
```

```
1290    T$=Time$(0)+"   "+Date$(0)\
        Input "Hey there old timer, what's your name";N$\
        Open "(1,6)GOLD.DAT" as File 1%\
        Print #1%,N$\
        Print #1%,Num$(D)\
        Print #1%,Num$(M)\
        Print #1%,T$\
        Close 1%\
        Print "Well ";N$;", you just broke";\
        Goto 1410
1380    Print "Consratulations!!! you tied";\
        Goto 1410
1400    Print "You didn't break";
1410    Print " the record of $";C\
        Print "Mined in";B;" days by ";M$\
        Print "on ";R$\
        Goto 1600
1450    Print FNP$(1%,15%);\
        Print "Consratulations!! You have mined a million dollars in"\
        Print "only";D;"days!"\
        Open "(1,6)GOLD.DAT" as File 2%\
        Gosub 1530\
        Goto 1400 If B<D\
        Goto 1380 If B=D\
        Goto 1290
1530    Input#2%,M$\
        Input#2%,B$\
        Input#2%,C$\
        Input#2%,R$\
        B=Val(B$)\
        C=Val(C$)\
        Close 2%\
        Return
1580    Print FNP$(1%,11%);\
        Print "Day ";Num1$(D);\
        Print Tab (12);\
        Print ", Profit is ";\
        Print Using "$########", M;\
        Return
1600    Print\
        Print\
        Input"Would you like to play again";A$\
        Goto 400 If Left(Cvt$$(A$,-1%),1)<>"N"\
        Print"Well then, it's been nice playing with you."\
        End
```

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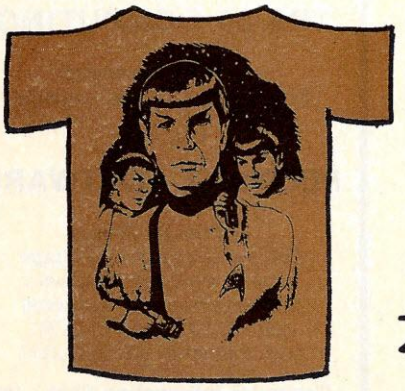

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Profiles of the IMSAI 8080, SWTPC 6800, TTY 43. All about EFTS. Computational unsolvability. Four new games. Gruenberger: "Learning by Doing." Catastrophic theory. A microcomputer software course.

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Ahl: "Computer Power ... People," Nelson: "A Dream ... Sherd," Arthur C. C... ure Communicatio... ok revealed. All about H... ies: Wave Mate Jupiter II, SOL-... AI in depth.

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Vol. 3, No. 5 - Sept/Oct 1977
Radio Shack computer profile, visit to Polymorphic, music synthesis for an 8080. Three views to computer conferencing. In-depth comparison of five BASIC interpreters. Fiction, computer and calculator games.

Vol. 3, No. 6 - Nov/Dec 1977
Programming techniques- Part 1. CAI. Topics in Logic. Three 8080 8K BASIC evaluations. Smart electronic game reviews. How computers can write final exams. Mastermind II and Otherllo computer games. Profile of the Alpha 1 and Alpha 2 for the TDL Xitan.

Vol. 4, No. 1 — Jan/Feb 1978
File structures, 16-bit computers, LOGO language, Murphy's laws, review of Radio Shack TRS-80 and Heath H8, World model, biorythms, how to write a simulation, Hart sort algorithm, 3 games, 8-Hour Basic Course - Part 4.

Vol. 4, No. 2 - Mar/Apr 1978
Parody of *Datamation*, Business Computing: 5 inventory control systems, ABCs of microcomputers, structured software for micros, four computer music systems, reviews of 2 Basic interpreters and micro-APL, CAI-Part 4, puzzles and games.

Vol. 4, No. 3 - May/Jun 1978
Art and animation section: 8 articles, color graphics, SAM76, binary search, a real budget in Basic, business computing: 4 payroll systems, Oregon Trail, Black Box, reviews of VideoBrain, MSI floppy, OSI Challenger, Ai speech synthesizer.

Vol. 4, No. 4 - Jul/Aug 1978
Reviews of Commodore PET, Apple II, Atari computer, Video games, interfacing to the real world: 5 articles, business computing: 4 word processing systems, ROM section: 7 articles, backgammon game, bar code.

Vol. 4, No. 5—Sep/Oct 1978
Equipment profiles: TRS-80, Exidy Sorcerer, Bally Arcade, PolyMorphic 8813, Merlin Video Display preview of nine new personal computers. Accounts receivable systems, All about PASCAL, real world games, a real time clock to build, PET cassettes, special education features, new software: Star Wars, Hex,

Vol. 4, No. 6—Nov/Dec 1978
Subject index and file index in BASIC, consumer computers buying guide, electronic game reviews, critical path analysis, mailing label programs, robot programming, experiment in teaching strategic thinking, evaluations of Northstar Horizon, CP/M operating system and backgammon computers, columns on Apple II PET and TRS-80, plus game section including "Corral", "Joust" and "Puzzle".

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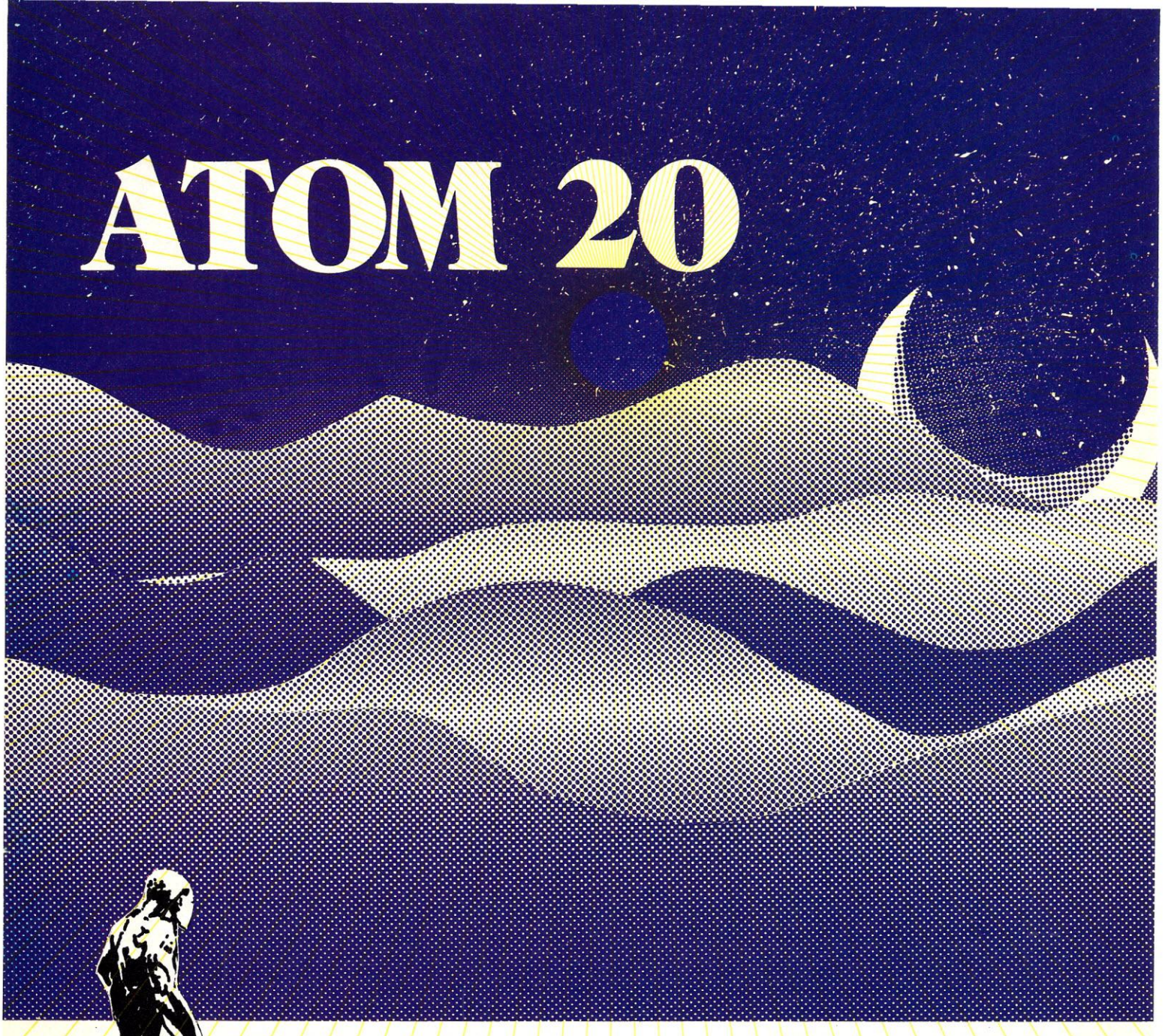
ATOM 20



Ray Brander

If you enjoyed trekking across the old west in Oregon Trail (May-June 1978 *Creative Computing*) then you'll be right at home in ATOM20, a fanciful simulation of survival after a worldwide nuclear war. In your adventures, you may face the dangers of radiation poisoning, dangerous animals, poisoned food, and more!

It seems that narrative simulation games of this type (such as Oregon Trail and Adventure, one of the ultimate computer games) are becoming increasingly popular, as game authors realize the possibilities of creating entire hypothetical worlds for exploration and adventuring. Another possibility would be to write a program which enables a user and the computer to write a story in cooperation. (This has been done in children's books by having the child's name inserted in the middle of the story in strategic places, but obviously the idea has much more potential.)

ATOM20 can be run in almost any BASIC, though you'll need a lot of memory to fit in all the descriptions. For a smaller machine, you could shorten the messages or the length of the game. The only conversion problem you might encounter is the SUBSTR (substring) function, used to look at the first character in a string. In other BASICs, this might be expressed as LEFT$(Z$,1) or Z$(1,1). (See line 7.) ATOM20 was written on the Minnesota Educational Computing Consortium's system ■

```
0 REM PROGRAM NAME - ATOM20       VERSION: 7/1/77
1 REM ALTERNATE NAMES - NONE
2 REM AUTHOR: RAY BRANDER, TWO HARBORS
3 REM CDC CYBER 70/73-26 BASIC 3.1
4 GOTO 5980
5 PRINT "DO YOU NEED INSTRUCTIONS";
6 INPUT Z$
7 Z$=SUBSTR(Z$,1,1)
8 IF Z$="N" THEN 230
9 IF Z$="Y" THEN 12
10 PRINT "PLEASE TYPE YES OR NO.  ";
11 GOTO 5
12 PRINT
13 PRINT "THE TIME IS THE YEAR 2000. AN ATOMIC WAR HAS"
20 PRINT "TAKEN PLACE, WIPING OUT A MAJOR PORTION OF THE"
30 PRINT "POPULATION. YOU HAVE BEEN LIVING WITHIN YOUR"
40 PRINT "BOMB SHELTER FOR THE LAST TWO MONTHS."
50 PRINT "YOUR FOOD RATION SUPPLY HAS NEARLY BEEN EXAUSTED."
60 PRINT "YOU MUST NOW GO OUT INTO THE NEW WORLD AND FIND"
70 PRINT "ANY FELLOW HUMAN BEINGS WHO HAVE SURVIVED THE WAR."
80 PRINT "THE FATE OF MANKIND LIES WITHIN YOUR HANDS."
90 PRINT
100 PRINT "YOU HAVE THE FOLLOWING FEW REMAINING SUPPLIES:"
105 PRINT
110 PRINT "3 DAY FOOD RATION SUPPLY."
120 PRINT "7 DAY WATER SUPPLY."
130 PRINT "1 RIFLE WITH 50 ROUNDS."
140 PRINT
145 PRINT
150 PRINT "THE DANGERS THAT LIE AHEAD ARE MANY. YOU MAY FALL"
160 PRINT "VICTIM TO RADIATION POISONING, A STROKE, A NATURAL"
170 PRINT "ACCIDENT, EATING POISONOUS FOODS, WILD ANIMALS,"
180 PRINT "OR EVEN CRAZED PEOPLE. DURING YOUR VOYAGE YOU MUST"
190 PRINT "USE YOUR RIFLE TO HUNT OR TO DEFEND YOURSELF. WHEN "
200 PRINT "ASKED TO TYPE THE WORD 'BANG', TYPE BANG AS FAST"
205 PRINT "AS YOU CAN. THE FASTER YOU TYPE THE WORD BANG THE"
210 PRINT "BETTER YOUR CHANCE OF HITTING YOUR TARGET. BE CAREFUL"
220 PRINT "HOW YOU USE YOUR BULLETS THOUGH, YOU ONLY HAVE 50"
225 PRINT "SHELLS FOR YOUR RIFLE."
230 PRINT
240 PRINT "DAY 1"
250 PRINT "YOU HAVE BEEN TRAVELING DOWN A ROAD OUT OF WHAT USED"
260 PRINT "TO BE YOUR TOWN. YOU HAVE COME ACROSS A SPLIT"
270 PRINT "IN THE ROAD. ARE YOU GOING TO TAKE THE LEFT OR RIGHT"
275 PRINT "FORK?"
280 INPUT A$
281 A$=SUBSTR(A$,1,1)
290 IF A$="L" THEN 3270
310 IF A$="R" THEN 335
311 PRINT "LEFT OR RIGHT!!!";
312 GOTO 280
335 PRINT
337 PRINT
340 PRINT "DAY 2"
350 PRINT "WHAT LUCK! A BIG HEALTHY BUCK IS STANDING IN"
360 PRINT "THE MIDDLE OF THE ROAD."
365 PRINT "TYPE BANG";
370 INPUT B$
380 IF B$="BANG" THEN 410
390 PRINT "AW, TOO BAD, YOU MISSED HIM. BETTER LUCK NEXT TIME."
400 GOTO 820
410 PRINT "GOOD SHOOTING. RIGHT THROUGH THE HEART. BUT"
420 PRINT "UNEXPECTEDLY, A HUGE BEAR HAS APPEARED ON THE"
430 PRINT "SCENE. YOU HAVE THE FOLLOWING CHOICES: 1) LEAVE THE"
440 PRINT "BEAR ALONE AND DEPART. 2) SHOOT THE BEAR. 3) GO"
450 PRINT "UP TO THE DEER AND TAKE SOME MEAT. CHOOSE ONE."
460 INPUT B
470 IF B=1 THEN 795
480 IF B=2 THEN 530
481 IF B=3 THEN 489
482 PRINT "PLEASE TYPE A 1, 2, OR 3";
483 GOTO 460
485 PRINT
489 PRINT
490 PRINT "A VERY FOOLISH DECISION. THE BEAR MAULED YOU TO"
500 PRINT "DEATH. MANKIND IS DOOMED TO EXTINCTION."
510 STOP
530 PRINT
540 PRINT "TYPE BANG";
550 INPUT C$
560 IF C$="BANG" THEN 620
561 PRINT
570 PRINT "YOU MISSED."
575 PRINT "THE BEAR CHASED YOU 200 YARDS "
580 PRINT "INTO THE WOODS. BESIDES LOSING 10 SHELLS DURING"
590 PRINT "THE CHASE, YOU ARE NOW LOST. YOU WASTE THE"
600 PRINT "REST OF YOUR DAY TRYING TO FIND THE ROAD."
610 GO TO 820
620 PRINT "BAD SHOOTING, YOU ONLY WOUNDED HIM. HE IS NOW"
630 PRINT "ANGRILY CHARGING AT YOU. YOU CAN 1) SHOOT AGAIN"
640 PRINT "OR 2) RUN."
650 INPUT C
660 IF C=2 THEN 575
661 IF C=1 THEN 669
662 PRINT "PLEASE TYPE A 1 OR 2";
663 GOTO 650
669 PRINT
670 PRINT "TYPE BANG";
680 INPUT D$
690  IF D$="BANG" THEN 740
691 PRINT
700 PRINT "YOU MISSED HIM THIS TIME. THE BEAR CAUGHT UP WITH"
710 PRINT "YOU AND MAULED YOU TO DEATH. MANKIND IS DOOMED"
720 PRINT "TO EXTINCTION."
730 STOP
740 PRINT "GOOD SHOOTING, YOU KILLED HIM. BUT HE WAS"
750 PRINT "RUNNING AT SUCH A HIGH SPEED HE COLLIDED INTO YOU."
760 PRINT "AS A RESULT OF THIS YOUR ARM HAS BEEN BROKEN, BUT"
770 PRINT"LOOK ON THE BRIGHT SIDE OF IT. YOU NOW HAVE A FOOD"
780 PRINT "SUPPLY."
790 GO TO 820
795 PRINT
800 PRINT "MAYBE YOU WILL FIND ANOTHER DEER SOME OTHER DAY."
810 PRINT
820 PRINT
825 IF X=5 THEN 3980
830 PRINT
840 PRINT "DAY 3"
850 PRINT "AT LAST! A HUMAN BEING! HE HAS JUST DASHED ACROSS"
860 PRINT "THE ROAD, ARE YOU GOING TO 1) CAPTURE HIM IMMED-"
870 PRINT "IATELY, 2) FOLLOW HIM, 3) COMPLETELY FORGET"
875 PRINT "ABOUT HIM?"
880 INPUT D
890 IF D=1 THEN 9350
900 IF D=2 THEN 960
901 IF D=3 THEN 905
902 PRINT "PLEASE TYPE A 1, 2, OR 3";
903 GOTO 880
905 PRINT
910 PRINT "WHAT! ARE YOU COMPLETELY CRAZY? HOW DO YOU THINK"
920 PRINT"YOU WILL COMPLETE YOUR MISSION OF REBUILDING MANKIND?"
930 PRINT "SINCE YOU WILL NOT TRY TO FIND ANY HUMANS YOUR MISSION"
940 PRINT "IS HERE BY TERMINATED."
950 STOP
960 PRINT
970 PRINT "GOOD THINKING. HOW MANY HOURS DO YOU WISH TO FOLLOW"
980 PRINT "HIM? 1,2,OR 3."
990 INPUT E
1000 IF E=3 THEN 1125
1010 IF E=2 THEN 1015
1011 IF E=1 THEN 1015
1012 PRINT "PLEASE TYPE A 1, 2, OR 3";
1013 GOTO 990
1015 PRINT
1020 PRINT "HE DID NOT LEAD YOU ANYWHERE BUT IN A CIRCLE"
1030 PRINT "BEFORE YOU CAUGHT UP WITH HIM. HIS NAME IS "
1040 PRINT "JOHN THOMAS. HE HAS NOT SEEN ANYONE AFTER THE"
1050 PRINT "WAR. ARE YOU GOING TO 1) LEAVE HIM, 2) STAY"
1055 PRINT "WITH HIM AND SEARCH?"
1060  INPUT F
1070 IF F=1 THEN 1095
1071 IF F=2 THEN 1075
1072 PRINT "PLEASE TYPE A 1 OR 2";
1073 GOTO 1060
1075 PRINT
1080 PRINT "GOOD THINKING! NOW THERE ARE TWO OF YOU"
1085 PRINT "TO SEARCH."
1090 GO TO 1230
1095 PRINT
1100 PRINT "SO YOU ARE GOING TO GO ON SEARCHING BY"
1105 PRINT "YOUR SELF. GOOD LUCK!"
1120 GO TO 1230
1125 PRINT
1127 IF Y=10 THEN 5910
1130 PRINT "GOOD THINKING! HE LED YOU TO HIS PARTNER, BILL"
1140 PRINT "HARDY, HE SAID HE HAD SEEN A GROUP OF PEOPLE"
1150 PRINT "MOVING WESTWARD. ARE YOU GOING TO 1) STAY WITH THEM"
1160 PRINT"OR 2) GO AFTER THE GROUP OF PEOPLE?"
1170 INPUT G
1180 IF G=1 THEN 9580
1181 IF G=2 THEN 1185
1182 PRINT "PLEASE TYPE A 1 OR 2";
1183 GOTO 1170
1185 PRINT
1190 PRINT "YOU STAY WITH THEM OVERNIGHT. THEY WISH YOU GOOD"
1200 PRINT"LUCK THE NEXT MORNING AND THEY HOPE YOU FIND"
1210 PRINT "THEM."
1220 GO TO 1230
1230 PRINT
1240 PRINT
1250 PRINT "DAY 4"
1260 PRINT "THE WEATHER FOR TODAY LOOKS BAD. YOU DECIDE"
1270 PRINT "TO GO AND CONTINUE SEARCHING. SUDDENLY, IT"
1280 PRINT "BEGINS TO RAIN HEAVILY. YOU CAN 1) STAY OUT AND"
1290 PRINT "CONTINUE SEARCHING OR 2) TRY AND FIND COVER."
1300 INPUT H
1310 IF H=2 THEN 1485
1311 IF H=1 THEN 1315
1312 PRINT "PLEASE TYPE A 1 OR 2";
1313 GOTO 1300
1315 PRINT
1317 PRINT
1320 PRINT "BECAUSE OF THE RAIN YOU CAUGHT A SEVERE COLD."
1330 PRINT "YOU HAVE A GOOD CHANCE OF COMING DOWN WITH"
1340 PRINT"PNEUMONIA. YOU MUST FIND GOOD WARM COVER SOON."
1341 PRINT
1342 PRINT
1350 PRINT "YOUR COUGHING HAS BECOME WORSE SINCE YOU CANNOT"
1360 PRINT "FIND COVER. UP AHEAD IS A CAVE. ARE YOU GOING TO"
1370 PRINT"ENTER? TYPE YES OR NO."
1380 INPUT E$
1385 E$=SUBSTR(E$,1,1)
1390 IF E$="Y" THEN 1445
1391 IF E$="N" THEN 1395
1392 PRINT "PLEASE TYPE YES OR NO";
1393 GOTO 1380
1395 PRINT
1400 PRINT "YOU HAVE COME DOWN WITH PNEUMONIA,"
1410 PRINT "AS NIGHT NEARED, THE TEMPERATURE DROPPED."
1420 PRINT "AS A RESULT YOU PASSED AWAY IN YOUR SLEEP."
1430 PRINT "MANKIND IS DOOMED TO EXTINCTION."
1440 STOP
1445 PRINT
1450 PRINT "IN THE CAVE YOU FIND DRY WOOD TO BUILD A"
1460 PRINT"FIRE. YOU HAVE SUCCESSFULLY WARDED OFF"
1470 PRINT "PNEUMONIA, BUT YOU WILL HAVE A COLD FOR A FEW "
1475 PRINT "DAYS."
1480 GO TO 1575
1485 PRINT
1495 PRINT  "YOU HAVE GREAT DIFFICULTY IN FINDING COVER."
1500 PRINT
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1510 PRINT "AT LAST, A CAVE! ARE YOU GOING TO ENTER? TYPE"
1520 PRINT "YES OR NO."
1530 INPUT F$
1531 F$=SUBSTR(F$,1,1)
1535 IF X=5 THEN 4960
1540 IF F$="Y" THEN 1445
1541 IF F$="N" THEN 1545
1542 PRINT "PLEASE TYPE YES OR NO";
1543 GOTO 1530
1545 PRINT
1550 PRINT "AS A RESULT YOU HAVE COME DOWN WITH A SEVERE COLD"
1555 PRINT "UP AHEAD IS ANOTHER CAVE. ARE YOU GOING TO"
1570 GO TO 1370
1575 PRINT
1577 IF X=5 THEN 5120
1580 PRINT
1583 PRINT
1585 PRINT
1590 PRINT "DAY 5"
1600 PRINT "WHAT LUCK, A TOWN IS UP AHEAD. MOST OF THE "
1610 PRINT "BUILDINGS HAVE BEEN LEVELED. BUT, A GROCERY STORE"
1620 PRINT"IS STILL STANDING. EVERYTHING HAS BEEN EATEN"
1630 PRINT "EXCEPT FOR SOME CANNED GOODS. MOST ARE DENTED AND"
1640 PRINT "HAVE SOME RUST. BUT THERE ARE A FEW THAT LOOK OK."
1650 PRINT "WHICH ONES ARE YOU GOING TO PICK ? A) SOME SOUPS"
1660 PRINT "B) SOME VEGETABLES OR C) SOME FRUITS."
1665 INPUT G$
1680  IF G$="A" THEN1820
1690 IF G$="B" THEN 1790
1691 IF G$="C" THEN 1700
1692 PRINT "PLEASE TYPE A, B, OR C";
1693 GOTO 1665
1700 PRINT
1710 PRINT "SO YOU LIKE FRUITS."
1720 PRINT "THE CANS YOU FOUND HAD SOME RUST, AND A COUPLE"
1730 PRINT "WERE DENTED. YOU ATE 4 FOR SUPPER, AND HOPE YOU"
1740 PRINT "DO NOT GET FOOD POISONING."
1750 PRINT
1760 IF Y=5 THEN 1976
1770 IF Y=10 THEN 1900
1780 IF Y=15 THEN 1940
1790 PRINT
1800 PRINT" SO YOU LIKE VEGETABLES."
1810 GO TO 1720
1820 PRINT
1830 PRINT "SO YOU LIKE SOUPS."
1840 PRINT "THE CANS YOU FOUND HAD SOME RUST, AND A COUPLE"
1850 PRINT "WERE DENTED. YOU ATE 4  FOR SUPPER, AND HOPE YOU"
1860 PRINT "DO NOT GET FOOD POISONING."
1870 IF Y=5 THEN 1900
1880 IF Y=10 THEN 1940
1890 IF Y=15 THEN 1976
1900 PRINT
1910 PRINT "THE CANS YOU ATE WERE POISONOUS. YOU DIED"
1920 PRINT "PEACEFULLY IN YOUR SLEEP."
1930  GO TO 1430
1940 PRINT
1950 PRINT "LUCK MUST BE ON YOUR SIDE. THE CANS YOU ATE"
1960  PRINT "WERE SAFE."
1970 GO TO 1995
1976 PRINT
1980 PRINT "ONE OF THE CANS YOU ATE WAS SLIGHTLY"
1985 PRINT "POISONOUS. YOU WAKE UP WITH A BAD CASE OF"
1990 PRINT "INDIGESTION."
1995 PRINT
2000 PRINT
2010 PRINT
2020 PRINT "DAY 6"
2030 PRINT "FINALLY! YOU SPOTTED THE GROUP OF PEOPLE UP"
2040 PRINT "AHEAD IN THE DISTANCE. YOU NOW HAVE TO MAKE"
2050 PRINT "THE FOLLOWING IMPORTANT DECISION. YOU CAN 1)GO"
2060 PRINT "STRAIGHT AHEAD THROUGH THE DESERT LIKE LAND OR"
2070 PRINT "2) CIRCLE AROUND THROUGH THE FOREST."
2080 INPUT I
2090 IF I=2 THEN 2220
2091 IF I=1 THEN 2100
2092 PRINT "PLEASE TYPE A 1 OR 2";
2093 GOTO 2080
2100 IF Y=5 THEN 2170
2110 PRINT
2120 PRINT "VERY FOOLISH. THE DESERT LIKE LAND IS THE RESULT"
2130 PRINT "OF AN ATOMIC BOMB. YOU RECIEVED A BAD DOSE OF"
2140 PRINT "GAMMA RAYS. RADIATION POISONING SET IN QUICKLY."
2150 PRINT "THE GROUP DISAPPEARED AND YOU DIED THE NEXT"
2155 PRINT "DAY, NEVER SEEING THE GROUP AGAIN."
2160 GO TO 1430
2170 PRINT
2180 PRINT "THE GROUP DISAPPEARED WHILE YOU WERE CROSSING"
2190 PRINT "THE SAND, BUT THEIR TRACKS ARE PLAINLY VISIBLE."
2200 PRINT "YOU SPEND THE DAY TRACKING THEM, GETTING"
2205 PRINT "EVER NEARER."
2210 GO TO 2720
2220 PRINT
2222 PRINT "YOU HAVE ONLY TRAVELED 300 FEET. WILD ANIMALS"
2230 PRINT "ARE ATTACKING. TYPE BANG";
2240 INPUT H$
2260 PRINT
2270 PRINT "YOU MISSED. ONE WOUNDED YOUR ARM BEFORE YOU "
2280 PRINT "DISPOSED OF HIM. THE OTHERS RAN A SHORT DISTANCE"
2290 PRINT "AWAY. THEY LOOK AS IF THEY INTEND TO RETURN. YOU"
2300 PRINT "CAN NOW A) RUN OR B) WAIT FOR THEM TO RETURN."
2310 INPUT I$
2320 IF I$="A" THEN 2380
2321 IF I$="B" THEN 2330
2322 PRINT "PLEASE TYPE A OR B";
2323 GOTO 2310
2330 PRINT
2340 PRINT "THE ANIMALS CAME BACK IN A FEW MINUTES. THIS"
2345 PRINT "TIME THEY HAVE CIRCLED YOU, COMING FROM ALL"
2350 PRINT "DIRECTIONS. BECAUSE OF YOUR WOUNDED ARM, YOU"
2360 PRINT "COULD NOT SHOOT STRAIGHT. YOU WERE EASY PREY."
2370 GO TO 1430
2380 PRINT
2390 PRINT "THE ANIMALS RETURNED AS YOU STARTED RUNNING. YOU"
2400 PRINT "HAD TO RUN FAST TO ESCAPE THEM. IN DOING SO,"
2405 PRINT "YOU LOST ALL OF YOUR SHELLS FOR YOUR RIFLE."
2410 PRINT "YOU BETTER DEVISE A MEANS OF DEFENSE SOON."
2430 PRINT
2440 PRINT "BY THE TIME YOU GOT OUT OF THE FOREST THE GROUP"
2450 PRINT "HAD DISAPPEARED. BUT THE TRACKS THEY LEFT"
2460 PRINT "BEHIND ARE PLAINLY VISIBLE. YOU SPEND THE REST "
2470 PRINT "OF THE DAY TRACKING THEM."
2480 PRINT
2485 PRINT
2490 PRINT "THAT NIGHT YOU BEGIN TO MAKE YOUR WEAPONS."
2500 PRINT "ARE YOU GOING TO MAKE A 1)SPEAR  2) BOW WITH"
2510 PRINT "ARROWS OR 3) AN AXE AND CLUB?"
2520 INPUT J
2530 IF J=1 THEN 2660
2540 IF J=2 THEN 2615
2541 IF J=3 THEN 2550
2542 PRINT "PLEASE TYPE A 1, 2, OR 3";
2543 GOTO 2520
2550 PRINT
2560 PRINT "YOU HAD TO SPEND 3 HOURS SEARCHING FOR A GOOD"
2570 PRINT "STONE AND SOME STRONG WOOD."
2580 PRINT "YOU SPENT MUCH OF THE NIGHT WORKING ON IT."
2590 PRINT "YOU OVERSLEPT THE NEXT MORNING, AND WILL HAVE TO"
2600 PRINT "DO SOME FAST TRAVELING TO CATCH UP WITH THEM."
2610 GO TO 2720
2615 PRINT
2620 PRINT "WHAT LUCK! YOU FOUND A PLIABLE PIECE OF WOOD FOR"
2630 PRINT "YOUR BOW, BUT YOU SPENT 2 HOURS SEARCHING FOR"
2640 PRINT "A GOOD CORD AND STRAIGHT PIECES FOR YOUR ARROWS."
2650 GO TO 2580
2660 PRINT
2670 PRINT
2680 PRINT "YOU HAD TO SPEND 2 HOURS SEARCHING FOR A GOOD,"
2690 PRINT "STRONG, LONG PIECE OF WOOD. GOOD THING YOU"
2700 PRINT "HAVE A KNIFE TO PUT ON THE END OF IT."
2710 GO TO 2580
2720 PRINT
2730 PRINT
2740 PRINT
2750 PRINT "DAY 7"
2760 PRINT "YOU HAVE BEEN TRACKING THEM ALL DAY,"
2770 PRINT "THE TRACKS GETTING FRESHER EVERY HOUR."
2780 PRINT
2790 PRINT "THAT NIGHT YOU SEE SOME CAMPFIRES UP"
2830 PRINT "AHEAD IN THE DISTANCE. YOU CAN SEE GLIMPSES"
2840 PRINT "OF PEOPLE MOVING AROUND THE CAMPFIRES."
2845 PRINT "MORNING, RISKING THE CHANCE OF THEM "
2850 PRINT "YOU HAVE THE FOLLOWING CHOICES. A) GO AND"
2860 PRINT "GREET THEM TONIGHT OR B)WAIT UNTIL "
2870 PRINT "MORNING, RISKING THE CHANCE OF THEM LEAVING"
2880 PRINT "BEFORE YOU AWAKEN."
2890 INPUT J$
2895 IF X=5 THEN 5820
2900 IF J$="B" THEN 3120
2901 IF J$="A" THEN 2905
2902 PRINT "PLEASE TYPE A OR B";
2903 GOTO 2890
2905 PRINT
2910 IF Y=15 THEN 3040
2920 PRINT
2930 PRINT "THEY GREETED YOU WITH OPEN ARMS."
2940 PRINT "APPARENTLY THEY HAVE NO LEADER, AND ARE WILLING"
2950 PRINT "TO ACCEPT YOU AS THEIR OWN."
2960 PRINT
2970 PRINT "YOU CAN NOW LEAD YOUR PEOPLE INTO A NEW AND"
2980 PRINT "AND BETTER LAND, BEGINNING THE TASK OF "
2990 PRINT "REBUILDING CIVILIZATION."
3000 PRINT
3010 PRINT "I GIVE YOU MY HEARTIEST CONGRADULATIONS AND"
3020 PRINT "WISH YOU THE BEST OF LUCK."
3030 STOP
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3040 PRINT "THE GROUP HAD PLANNED TO MAKE THIS THEIR"
3050 PRINT "SEMI-PERMANENT HOME. WHILE YOU WERE"
3060 PRINT "TRACKING THEM THEY HAD SET UP SNARES AND DUG"
3070 PRINT "SOME PITS WITH UPWARD STAKES. YOU COULD NOT SEE"
3080 PRINT "THE PIT IN THE DARK, THEREFORE YOU FELL INTO"
3090 PRINT "THE PIT."
3100 GO TO 1430
3120 PRINT
3130 PRINT "DAY 8"
3140 PRINT "THE GROUP WAS SLEEPING WHEN YOU AWOKE. YOU"
3150 PRINT "WENT UP INTO THE CAMP."
3155 IF X=5 THEN 5890
3160 IF Y=10 THEN 3190
3170 PRINT "YOU HAD TO AWAKEN SOME OF THE MEN."
3180 GO TO 2940
3190 PRINT
3200 PRINT "WHEN YOU ENTERED THE CAMP, THE NEAREST PERSON"
3210 PRINT "WAS A YOUNG GIRL. AS YOU AWAKENED HER, SHE SAW"
3220 PRINT "YOUR FACE AND DID NOT RECOGNIZE YOU, AND THEREFORE"
3230 PRINT "SCREAMED AND BEGAN FIGHTING YOU. SOME OF THE"
3240 PRINT "MEN WOKE UP AND THOUGHT YOU WERE ATTACKING"
3250 PRINT "HER. THEY HAD RIFLES AND SHOT BEFORE ASKING."
3260 GO TO 1430
3270 PRINT
3280 PRINT
3290 PRINT
3300 PRINT "DAY 2"
3310 PRINT "UP AHEAD IS A TOWN. IT IS COMPLETELY LEVEL."
3320 PRINT "ARE YOU GOING TO 1) PASS THROUGH THE TOWN OR 2)"
3330 PRINT "CIRCLE AROUND THROUGH THE FOREST?"
3340 INPUT A
3350 IF A=2 THEN 3480
3351 IF A=1 THEN 3360
3352 PRINT "PLEASE TYPE A 1 OR 2";
3353 GOTO 3340
3360 IF Y=10 THEN 3440
3370 PRINT
3380 PRINT "THE TOWN WAS DESTROYED BY AN ATOMIC BOMB."
3390 PRINT "AS YOU PASSED THROUGH THE TOWN, YOU RECIEVED"
3400 PRINT "A BAD DOSE OF GAMMA RAYS. AS A RESULT OF THIS"
3410 PRINT "YOU CAME DOWN WITH RADIATION POISONING."
3420 PRINT "YOU SURVIVED THE REST OF THE DAY AND DIED THAT"
3425 PRINT "NIGHT."
3430 GO TO 1430
3440 PRINT
3450 PRINT "LUCKY FOR YOU THE RADIATION LEVEL HAD DECREASED"
3460 PRINT "TO BE SAFE FOR HUMANS. YOU PASSED THROUGH"
3465 PRINT "THE TOWN SAFELY."
3470 GO TO 3900
3480 PRINT
3490 PRINT "AS YOU TRAVEL THROUGH THE FOREST YOU HEAR A"
3500 PRINT "SNARL BEHIND YOU. YOU TURN AROUND TO FIND"
3510 PRINT "AN ANGRY WOLVERINE STALKING YOU."
3520 PRINT "TYPE BANG";
3530 INPUT B$
3540 IF B$="BANG" THEN 3660
3560 PRINT
3570 IF Y=15 THEN 3630
3580 PRINT "YOU MISSED. BUT WAIT! YOUR BULLET HIT A ROCK"
3590 PRINT "AND RICOCHETED BACK AND HIT THE WOLVERINE,"
3600 PRINT "KILLING HIM INSTANTLY. YOU TRAVERSED THE REST OF"
3610 PRINT "THE FOREST IN SAFETY."
3620 GO TO 3900
3630 PRINT "THE WOLVERINE WAS AS WILD AND STRONG AS"
3640 PRINT "A CORNERED BEAR. YOU DID NOT LAST LONG."
3650 GO TO 1430
3660 PRINT "YOU MISSED. LUCKILY FOR YOU THE WOLVERINE WAS"
3670 PRINT "FRIGHTENED BY THE NOISE OF THE SHOT. BUT YOU"
3680 PRINT "YOU MUST REALIZE THAT WOLVERINES ARE STUBBORN"
3690 PRINT "CREATURES AND THERE IS A GOOD CHANCE HE MAY"
3700 PRINT "RETURN. YOU CAN 1)WAIT FOR THE WOLVERINE TO"
3710 PRINT "RETURN OR 2) RUN."
3720 INPUT B
3730 IF B=2 THEN 3840
3731 IF B=1 THEN 3740
3732 PRINT "PLEASE TYPE A 1 OR 2";
3733 GOTO 3720
3740 IF Y=5 THEN 3800
3750 PRINT
3760 PRINT "IN ADDITION TO BEING STUBBORN, A WOLVERINE"
3770 PRINT "IS ALSO INTELLIGENT. WHILE YOU WERE WAITING HE"
3780 PRINT "APPROACHED YOU FROM BEHIND AND ATTACKED YOU."
3790 GO TO 3630
3800 PRINT
3810 PRINT "YOU SAT THERE 3 HOURS AND NO WOLVERINE SHOWED"
3820 PRINT"UP. THIS MUST JUST BE ONE OF THOSE DAYS."
3830 GO TO 3900
3840 PRINT
3850 PRINT "THE WOLVERINE RETURNED AS YOU STARTED RUNNING."
3860 PRINT "YOU HAD TO RUN FAST TO ESCAPE HIM. WHILE"
3870 PRINT "YOU WERE RUNNING YOU STEPPED INTO A HOLE,"
3880 PRINT "SPRAINING YOUR FOOT. LOOK ON THE BRIGHT"
3890 PRINT "SIDE THOUGH, YOU ESCAPED THE WOLVERINE."
3900 PRINT
3910 PRINT
3920 PRINT
3930 PRINT "DAY 3"
3940 PRINT "TODAY YOU DECIDE TO TRAVEL DOWN A"
3950 PRINT "ROAD THAT YOU HAVE COME ACROSS."
3960 LET X=5
3970 GO TO 350
3980 PRINT
3990 PRINT "LATER THAT DAY YOU MET TWO STRANGERS."
4000 PRINT "THEIR NAMES ARE NICK CARLSON AND TOM JOHNSON."
4010 PRINT "EARLIER THAT DAY THEY SAW A GROUP OF PEOPLE GOING"
4020 PRINT "WESTWARD. ARE YOU GOING TO 1) STAY WITH THEM"
4030 PRINT "OR 2) GO AFTER THE GROUP OR 3) COMPLETELY FORGET"
4040 PRINT "ABOUT THE GROUP?"
4050 INPUT C
4060 IF C=1 THEN 9580
4070 IF C=2 THEN 4090
4080 IF C=3 THEN 905
4090 PRINT
4091 PRINT "PLEASE TYPE A 1, 2, OR 3";
4092 GOTO 4050
4100 PRINT
4110 PRINT
4120 PRINT "DAY 4"
4130 PRINT "YOU FOUND OUT THE GROUP WAS FOLLOWING A"
4140 PRINT "A HIGHWAY LEADING TO A RIVER, AND THEY HAVE"
4150 PRINT "A GOOD LONG LEAD ON YOU."
4160 PRINT
4170 PRINT
4180 PRINT "WHAT LUCK, YOU HAVE COME ACROSS A CAR THAT"
4190 PRINT "HAS SOME GAS AND THE KEYS ARE INSIDE. YOU"
4200 PRINT "DECIDE TO USE THE CAR. ON YOUR WAY YOU COME TO"
4210 PRINT "A LONG STRETCH. YOU DECIDE TO PUSH"
4220 PRINT "THE ACCELERATOR DOWN TO THE FLOOR TO SEE"
4230 PRINT "HOW FAST THE CAR WOULD GO."
4240 IF Y=5 THEN 4320
4250 PRINT
4260 PRINT "THE CAR REACHED A SPEED OF 110. YOU HAD"
4270 PRINT "TO SLOW DOWN RAPIDLY BEFORE YOU ENTERED A"
4280 PRINT "SHARP CURVE. AS A RESULT THE CAR WAS OVER"
4290 PRINT "TURNED. YOU HAD TO LEAVE THE VEHICLE AND START"
4300 PRINT "OUT ON FOOT."
4310 GO TO 4410
4320 PRINT
4330 PRINT "THE CAR REACHED A SPEED OF 110. YOU HAD"
4340 PRINT "TO APPLY THE BRAKES BEFORE ENTERING THE"
4350 PRINT "SHARP CURVE UP AHEAD. AS YOU APPLIED THE"
4360 PRINT "BRAKES THEY WENT DOWN TO THE FLOOR WITH NO"
4370 PRINT "RESULT. YOU ENTERED THE CURVE AT 100 MILES"
4380 PRINT "PER HOUR AND WENT STRAIGHT INTO A HUGE"
4390 PRINT "BOULDER. YOU DIED INSTANTLY."
4400 GO TO 1430
4410 PRINT
4420 PRINT
4430 PRINT
4440 PRINT "DAY 5"
4450 PRINT "TODAY YOU SAW THE GROUP DISSAPPEAR OVER THE CREST"
4460 PRINT "OF A HILL ABOUT A MILE AHEAD. YOU DECIDE TO FOLLOW"
4470 PRINT "THEM."
4480 PRINT
4490 PRINT "WHEN YOU REACH THE TOP OF THE HILL ONLY THEIR"
4500 PRINT "TRACKS WERE VISIBLE. THERE IS "
4510 PRINT "A WIDE RIVER. THE BRIDGE SPANNING THE RIVER"
4520 PRINT "HAS BEEN DESTROYED. ON YOUR SIDE IS A SMALL BOAT,"
4530 PRINT "ON THE OTHER SIDE ARE 4 SLIGHTLY LARGER BOATS."
4540 PRINT "YOU CAUGHT A GLIMPSE OF A BOAT DISAPPEARING"
4550 PRINT "AROUND A BEND IN THE RIVER. ARE YOU GOING TO A)CROSS"
4560 PRINT "THE RIVER OR B) FOLLOW THE BOAT DOWNSTREAM."
4570 INPUT C$
4580 IF C$="A" THEN 4780
4581 IF C$="B" THEN 4590
4582 PRINT "PLEASE TYPE A OR B";
4583 GOTO 4570
4590 IF Y=5 THEN 4700
4600 PRINT
4610 PRINT "AS YOU WENT AFTER THE BOAT, YOU DISCOVERED THAT"
4620 PRINT "THE RIVER CONTINUOUSLY TWISTED AND TURNED, SO THAT"
4630 PRINT "YOU COULD ONLY CATCH GLIMPSES OF THE BACK END OF"
4640 PRINT "THE BOAT. YOU FOLLOWED THE BOAT 2 AND A HALF MILES"
4650 PRINT "DOWNSTREAM BEFORE YOU FOUND OUT THAT THE BOAT WAS"
4660 PRINT "EMPTY. YOU WILL HAVE TO DO SOME FAST TRAVELING TO "
4670 PRINT "MAKE UP FOR YOUR LOST TIME."
4690 GO TO 4910
4700 PRINT
4710 PRINT "AS YOU WENT AROUND THE BEND YOUR BOAT STARTED"
4720 PRINT "GOING FASTER. YOU COULD HEAR A MUFFLED ROAR AROUND"
4730 PRINT "THE NEXT BEND. AS YOU WENT AROUND THE NEXT BEND"
4740 PRINT "YOU COULD SEE A WATERFALL UP AHEAD. YOU NO LONGER"
4750 PRINT "HAD ANY CONTROL OVER YOUR BOAT. YOU FELL OVER 400"
4760 PRINT "FEET TO YOUR DEATH."
4770 GO TO 1430
4780 PRINT
4790 IF Y=10 THEN 4840
4800 PRINT "WHEN YOU REACHED THE OTHER SIDE OF THE RIVER"
4810 PRINT "YOU FOUND TRACKS ON THE OTHER SIDE. IT APPEARS THAT"
4820 PRINT "THEY ARE GOING TO CONTINUE TO FOLLOW THE ROAD."
4830 GO TO 4910
4840 PRINT
4850 PRINT "AS YOU GOT HALF WAY ACROSS THE CURRENT TOOK"
4860 PRINT "YOUR BOAT DOWNSTRAM TOWARDS THE BEND. YOU ARE"
4870 PRINT "LOSING CONTROL OF YOUR BOAT. YOU BETTER DO"
4880 PRINT "SOMETHING FAST."
4890 PRINT
4900 GO TO 4700
4910 PRINT
4920 PRINT
4930 PRINT
4940 PRINT "DAY 6"
4950 GO TO 1260
4960 IF F$="Y" THEN 4980
4970 GOTO 1541
4980 IF Y=15 THEN 5000
4985 IF Y=10 THEN 5060
4990 GO TO 1445
5000 PRINT
5020 PRINT "BECAUSE IT WAS TOO DARK, YOU FELL OVER A HUGE"
5030 PRINT "SLEEPING BEAR. HE DID NOT APPRECIATE BEING WOKEN"
5040 PRINT "UP, SO HE PUT YOU TO SLEEP FOR GOOD."
5050 GO TO 1430
5060 PRINT
5070 PRINT "WHEN YOU ENTERED THE CAVE YOU DISCOVERED IT"
5080 PRINT "WAS DAMP AND COLD. YOU HAD TO GO AND FIND"
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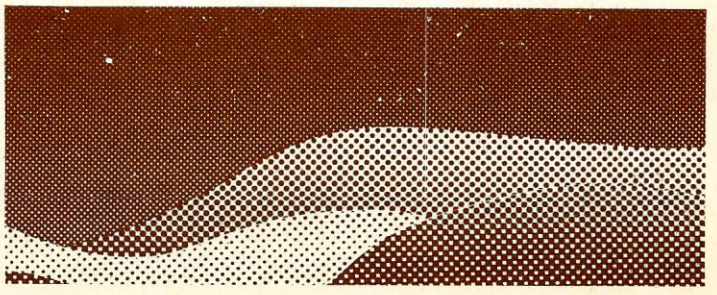

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5090 PRINT "ANOTHER CAVE WHERE IT IS DRY."
5100 PRINT "AT LAST, A CAVE! ARE YOU GOING TO"
5110 GO TO 1370
5120 PRINT
5130 PRINT
5140 PRINT
5150 PRINT "DAY 7"
5160 PRINT "TODAY AS YOU WERE TRACKING THE GROUP YOU"
5170 PRINT "SUDDENLY FELT A SHARP PAIN AT YOUR ANKLE. YOU"
5180 PRINT "STOPPED TO FIND THAT A RATTLESNAKE HAD BITTEN"
5190 PRINT "YOU. YOU BETTER FIND A MEDICAL BOX SOON."
5200 PRINT
5210 PRINT "YOU ARE BEGINNING TO FEEL WEAK. YOU MUST"
5220 PRINT "FIND SOME MEDICINE SOON."
5230 PRINT
5240 PRINT "FINALLY! YOU HAVE FOUND A MEDICINE BOX. ARE"
5250 PRINT "YOU GOING TO USE IT?"
5260 INPUT G$
5261 G$=SUBSTR(G$,1,1)
5270 IF G$="Y" THEN 5320
5271 IF G$="N" THEN 5280
5272 PRINT "PLEASE TYPE YES OR NO";
5273 GOTO 5260
5280 PRINT
5290 PRINT "SINCE YOU DID NOT USE ANY OF THE MEDICINE"
5300 PRINT "YOU DIED FROM POISONING."
5310 GO TO 1430
5320 PRINT
5330 PRINT "AS YOU OPENED THE BOX YOU FOUND 3 BOTTLES."
5340 PRINT "UNFORTUNATELY, THE 3 BOTTLES ARE NOT LABELED."
5350 PRINT "ARE YOU GOING TO TAKE 1) BOTTLE A, 2) BOTTLE"
5360 PRINT "B OR 3) BOTTLE C?"
5370 INPUT E
5380 IF E=1 THEN 5410
5390 IF E=2 THEN 5460
5400 IF E=3 THEN 5520
5401 PRINT "PLEASE TYPE A 1, 2, OR 3";
5402 GOTO 5370
5410 PRINT
5420 PRINT "YOU TOOK ONE PILL, HOPING THAT IT WILL CURE YOU."
5430 IF Y=5 THEN 5620
5440 IF Y=10 THEN 5660
5450 IF Y=15 THEN 5710
5460 PRINT
5470 PRINT "WITHIN THE BOTTLE WERE 7 SMALL PILLS. YOU"
5480 PRINT "TOOK 2, HOPING THEY WOULD CURE YOU."
5490 IF Y=5 THEN 5660
5500 IF Y=10 THEN 5710
5510 IF Y=15 THEN 5620
5520 PRINT
5530 PRINT "IN THE BOTTLE ARE TWO DIFFERENT PILLS. ARE"
5540 PRINT "YOU GOING TO TAKE 1) THE RED PILL OR "
5545 PRINT "2) THE BLACK PILL ?"
5550 INPUT F
5560 IF F=1 THEN 5610
5561 IF F=2 THEN 5570
5562 PRINT "PLEASE TYPE A 1 OR 2";
5563 GOTO 5550
5570 PRINT "YOU NOW HOPE THE PILL WILL CURE YOU."
5580 IF Y=5 THEN 5710
5590 IF Y=10 THEN 5620
5600 IF Y=15 THEN 5660
5610 IF Y=5 THEN 5570
5620 PRINT
5630 PRINT "THE PILL YOU TOOK WAS CYANIDE. YOU DIED"
5640 PRINT "SWIFTLY AND PAINLESSLY."
5650 GO TO 1430
5660 PRINT
5670 PRINT "YOU MUST BE VERY LUCKY. THE PILL YOU TOOK"
5680 PRINT "CURED YOU. YOU CAN NOW CONTINUE ON YOUR"
5690 PRINT "WAY AFTER THE GROUP."
5700 GO TO 5770
5710 PRINT
5720 PRINT "THE PILL YOU TOOK HAD VERY LITTLE EFFECT."
5730 PRINT "LUCKY FOR YOU THE SNAKE WAS NOT POISONOUS"
5740 PRINT "ENOUGH FOR YOU TO DIE AND YOUR BODY COULD"
5750 PRINT "RECOVER."
5760 GO TO 5770
5770 PRINT
5780 PRINT
5790 PRINT
5800 PRINT "DAY 8"
5810 GO TO 2760
5820 IF J$="B" THEN 5850
5821 IF J$="A" THEN 5830
5822 PRINT "PLEASE TYPE A OR B";
5823 GOTO 2890
5830 IF Y=10 THEN 3040
5840 GO TO 2920
5850 PRINT
5860 PRINT
5870 PRINT "DAY 9"
5880 GO TO 3140
5890 IF Y=15 THEN 3190
5900 GO TO 3170
5910 PRINT
5920 PRINT "BAD THINKING. WHILE FOLLOWING HIM HE"
5930 PRINT "DISAPPEARED WITHOUT A TRACE. BECAUSE OF"
5940 PRINT "YOUR CARELESSNESS YOU HAVE LOST YOUR ONLY"
5950 PRINT "LINK TO MANKIND. IF THIS IS THE WAY YOU ARE"
5960 PRINT "GOING TO TREAT YOUR MISSION, YOUR MISSION"
5965 PRINT "IS HEREBY TERMINATED."
5970 STOP
5980 LET W=INT(4*RND(1))
5990 IF W=0 THEN 6030
6000 IF W=1 THEN 6050
6010 IF W=2 THEN 6030
6020 IF W=3 THEN 6070
6030 LET Y=5
6040 GO TO 9926
6050 LET Y=10
6060 GO TO 9926
6070 LET Y=15
6080 GO TO 9926
9350 PRINT
9360 IF Y=15 THEN 9500
9370 PRINT "HE RESISTED YOU AT FIRST, UNTIL HE FOUND OUT"
9380 PRINT "WHO YOU WERE. HE TOOK YOU TO HIS BROTHER,"
9390 PRINT "OLIVER ANDERSON. BOTH OF THEM SAW A SMALL"
9400 PRINT "GROUP OF PEOPLE MOVING WESTWARD. ARE YOU GOING"
9410 PRINT "TO 1)FOLLOW THE GROUP OR 2)STAY WITH THEM?"
9420 INPUT S
9430 IF S=1 THEN 9450
9440 IF S=2 THEN 9560
9441 PRINT "PLEASE TYPE A 1 OR 2";
9442 GOTO 9420
9450 PRINT
9460 PRINT "YOU STAY WITH THEM OVERNIGHT. THE NEXT MORNING"
9470 PRINT "THEY GIVE YOU A SMALL FOOD SUPPLY. BOTH OF THEM"
9480 PRINT "HOPE YOU FIND THE GROUP."
9490 GO TO 1230
9500 PRINT
9510 PRINT "HE THOUGHT YOU WERE ANOTHER THIEF. UNFORTUNATELY"
9520 PRINT "HE HAD A REVOLVER AND SHOT BEFORE ASKING."
9530 GO TO 1430
9560 PRINT
9580 PRINT
9590 PRINT "NOTHING OF IMPORTANCE HAPPENS THE REST"
9600 PRINT "OF THE DAY."
9610 PRINT
9620 PRINT
9625 PRINT "DAY 4"
9630 PRINT "YOU AND YOUR PARTNERS ARE GOING HUNTING TODAY."
9640 PRINT "UP AHEAD IS A HERD OF WILD CATTLE ROAMING AROUND."
9650 PRINT "ALL THREE OF YOU COME UP FROM THE REAR."
9655 Q=0
9660 PRINT "TYPE BANG";
9665 Q=Q+1
9670 INPUT Y$
9680 IF Y$="BANG" THEN 9730
9690 PRINT
9695 IF Q>4 THEN 9740
9700 PRINT
9710 PRINT "YOU MISSED. SHOOT AGAIN."
9720 GO TO 9660
9730 PRINT
9740 PRINT "THE CATTLE BECAME FRIGHTENED AS THEY HEARD THE SHOTS."
9750 PRINT "THEY TURNED AROUND AND STAMPEDED IN YOUR "
9760 PRINT "DIRECTION. YOU MUST NOW RUN."
9770 PRINT
9780 IF Y=10 THEN 9840
9790 PRINT
9800 PRINT "YOU MADE IT TO A TREE IN TIME. UNFORTUNATELY"
9810 PRINT "YOUR FRIENDS DID NOT. YOU ARE NOW FORCED TO GO"
9820 PRINT "AFTER THE GROUP OF PEOPLE."
9825 IF X=5 THEN 4410
9830 GO TO 1575
9840 PRINT
9850 PRINT "YOUR FRIENDS MADE IT TO THE TREES IN TIME."
9860 PRINT "UNFORTUNATELY, YOU DID NOT."
9870 GO TO 1430
9926 GOTO 5
99999 END
READY.
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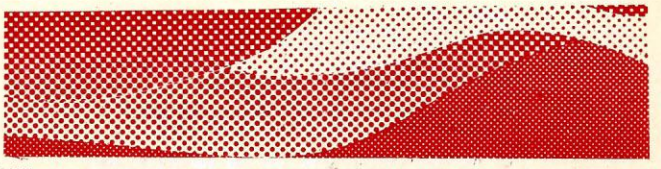

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RUN

DO YOU NEED INSTRUCTIONS? YES

THE TIME IS THE YEAR 2000. AN ATOMIC WAR HAS
TAKEN PLACE, WIPING OUT A MAJOR PORTION OF THE
POPULATION. YOU HAVE BEEN LIVING WITHIN YOUR
BOMB SHELTER FOR THE LAST TWO MONTHS.
YOUR FOOD RATION SUPPLY HAS NEARLY BEEN EXAUSTED.
YOU MUST NOW GO OUT INTO THE NEW WORLD AND FIND
ANY FELLOW HUMAN BEINGS WHO HAVE SURVIVED THE WAR.
THE FATE OF MANKIND LIES WITHIN YOUR HANDS.

YOU HAVE THE FOLLOWING FEW REMAINING SUPPLIES

3 DAY FOOD RATION SUPPLY.
7 DAY WATER SUPPLY.
1 RIFLE WITH 50 ROUNDS.


THE DANGERS THAT LIE AHEAD ARE MANY. YOU MAY FALL
VICTIM TO RADIATION PIOSONING, A STROKE, A NATURAL
ACCIDENT, EATING POISONOUS FOODS, WILD ANIMALS,
OR EVEN CRAZED PEOPLE. DURING YOUR VOYAGE YOU MUST
USE YOUR RIFLE TO HUNT OR TO DEFEND YOURSELF. WHEN
ASKED TO TYPE THE WORD 'BANG', TYPE BANG AS FAST
AS YOU CAN. THE FASTER YOU TYPE THE WORD BANG THE
BETTER YOUR CHANCE OF HITTING YOUR TARGET. BE CAREFUL
HOW YOU USE YOUR BULLETS THOUGH, YOU ONLY HAVE 50
SHELLS FOR YOUR RIFLE.
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```
DAY 1
YOU HAVE BEEN TRAVELING DOWN A ROAD OUT OF WHAT USED
TO BE YOUR TOWN. YOU HAVE COME ACROSS A SPLIT
IN THE ROAD. ARE YOU GOING TO TAKE THE LEFT OR RIGHT
FORK?
? LEFT



DAY 2
UP AHEAD IS A TOWN. IT IS COMPLETELY LEVEL.
ARE YOU GOING TO 1) PASS THROUGH THE TOWN OR 2)
CIRCLE AROUND THROUGH THE FOREST?
? 1

THE TOWN WAS DESTROYED BY AN ATOMIC BOMB.
AS YOU PASSED THROUGH THE TOWN, YOU RECIEVED
A BAD DOSE OF GAMMA RAYS, AS A RESULT OF THIS
YOU CAME DOWN WITH RADIATION POISONING.
YOU SURVIVED THE REST OF THE DAY AND DIED THAT
NIGHT.
MANKIND IS DOOMED TO EXTINCTION.

RUN COMPLETE.



DO YOU NEED INSTRUCTIONS? NO

DAY 1
YOU HAVE BEEN TRAVELING DOWN A ROAD OUT OF WHAT USED
TO BE YOUR TOWN. YOU HAVE COME ACROSS A SPLIT
IN THE ROAD. ARE YOU GOING TO TAKE THE LEFT OR RIGHT
FORK?
? RIGHT

DAY 2
WHAT LUCK! A BIG HEALTHY BUCK IS STANDING IN
THE MIDDLE OF THE ROAD.
TYPE BANG ? BANG
GOOD SHOOTING. RIGHT THROUGH THE HEART. BUT
UNEXPECTEDLY, A HUGE BEAR HAS APPEARED ON THE
SCENE. YOU HAVE THE FOLLOWING CHOICES: 1) LEAVE THE
BEAR ALONE AND DEPART. 2) SHOOT THE BEAR. 3) GO
UP TO THE DEER AND TAKE SOME MEAT. CHOOSE ONE.
? 2

TYPE BANG ? BANG
BAD SHOOTING, YOU ONLY WOUNDED HIM. HE IS NOW
ANGRILY CHARGING AT YOU. YOU CAN 1) SHOOT AGAIN
OR 2) RUN.
? 1

TYPE BANG ? BANG
GOOD SHOOTING, YOU KILLED HIM. BUT HE WAS
RUNNING AT SUCH A HIGH SPEED HE COLLIDED INTO YOU.
AS A RESULT OF THIS YOUR ARM HAS BEEN BROKEN, BUT
LOOK ON THE BRIGHT SIDE OF IT. YOU NOW HAVE A FOOD
SUPPLY.


DAY 3
AT LAST! A HUMAN BEING! HE HAS JUST DASHED ACROSS
THE ROAD, ARE YOU GOING TO 1) CAPTURE HIM IMMED-
IATELY, 2) FOLLOW HIM, 3) COMPLETELY FORGET
ABOUT HIM?
? 2

GOOD THINKING. HOW MANY HOURS DO YOU WISH TO FOLLOW
HIM? 1,2,OR 3.
? 2

HE DID NOT LEAD YOU ANYWHERE BUT IN A CIRCLE
BEFORE YOU CAUGHT UP WITH HIM. HIS NAME IS
JOHN THOMAS. HE HAS NOT SEEN ANYONE AFTER THE
WAR. ARE YOU GOING TO 1) LEAVE HIM, 2) STAY
WITH HIM AND SEARCH?
? 2

GOOD THINKING! NOW THERE ARE TWO OF YOU
TO SEARCH.


DAY 4
THE WEATHER FOR TODAY LOOKS BAD. YOU DECIDE
TO GO AND CONTINUE SEARCHING. SUDDENLY, IT
BEGINS TO RAIN HEAVILY. YOU CAN 1) STAY OUT AND
CONTINUE SEARCHING OR 2) TRY AND FIND COVER.
? 2

YOU HAVE GREAT DIFFICULTY IN FINDING COVER.

AT LAST, A CAVE! ARE YOU GOING TO ENTER? TYPE
YES OR NO.
? YES

IN THE CAVE YOU FIND DRY WOOD TO BUILD A
FIRE. YOU HAVE SUCCESSFULLY WARDED OFF
PNEUMONIA, BUT YOU WILL HAVE A COLD FOR A FEW
DAYS.



DAY 5
WHAT LUCK, A TOWN IS UP AHEAD. MOST OF THE
BUILDINGS HAVE BEEN LEVELED. BUT, A GROCERY STORE
IS STILL STANDING. EVERYTHING HAS BEEN EATEN
EXCEPT FOR SOME CANNED GOODS. MOST ARE DENTED AND
HAVE SOME RUST. BUT THERE ARE A FEW THAT LOOK OK.
WHICH ONES ARE YOU GOING TO PICK ? A) SOME SOUPS
B) SOME VEGETABLES OR C) SOME FRUITS.
? A

SO YOU LIKE SOUPS.
THE CANS YOU FOUND HAD SOME RUST, AND A COUPLE
WERE DENTED. YOU ATE 4  FOR SUPPER, AND HOPE YOU
DO NOT GET FOOD POISONING.

THE CANS YOU ATE WERE POISONOUS. YOU DIED
PEACEFULLY IN YOUR SLEEP.
MANKIND IS DOOMED TO EXTINCTION.

RUN COMPLETE.
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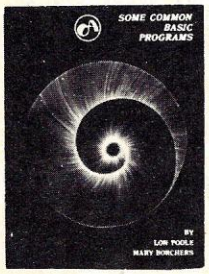

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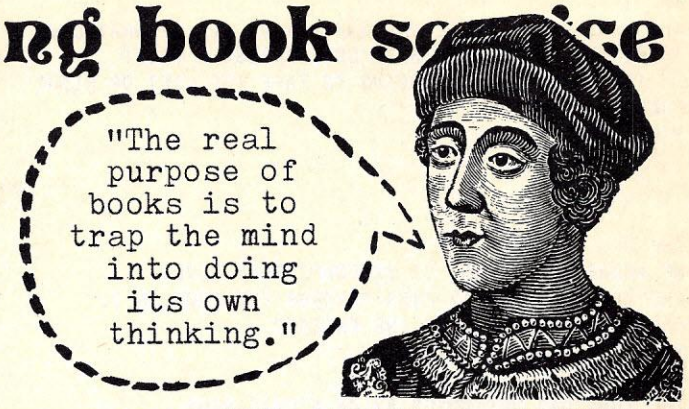

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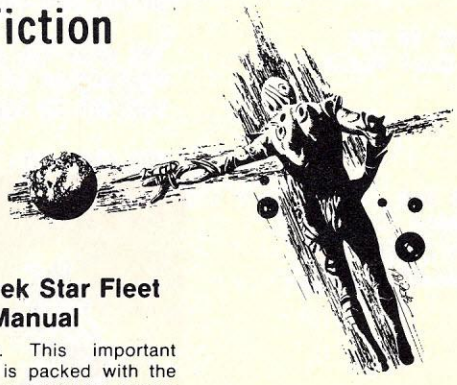

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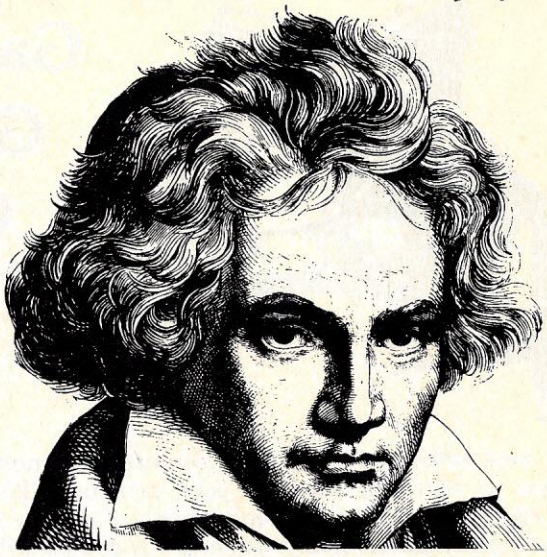

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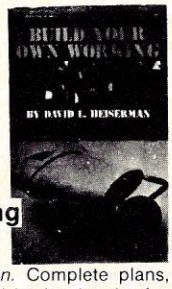

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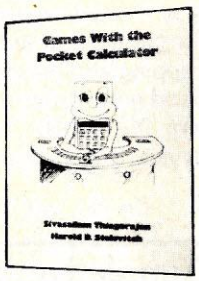

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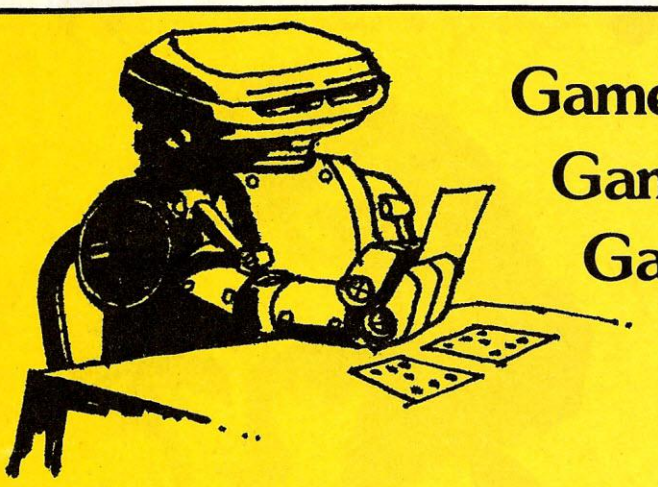

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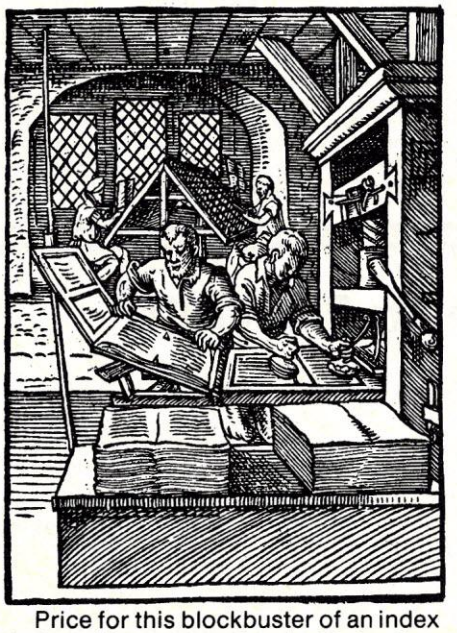

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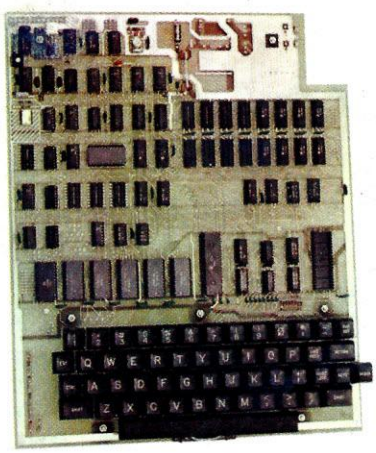

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